STORMWATER REPORT

Groton Senior Center

163 West Main Street

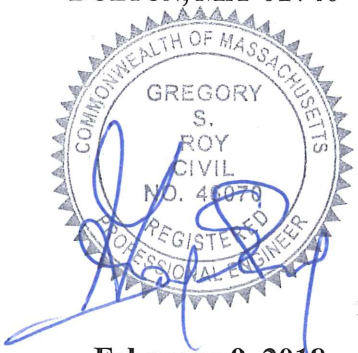
GROTON, MASSACHUSETTS

Prepared For:

TOWN OF GROTON
173 MAIN STREET
GROTON, MA 01450

Prepared By:

DUCHARME & DILLIS CIVIL
DESIGN GROUP, INC
1092 MAIN STREET
BOLTON, MA 01740



February 9, 2018

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DUCHARME & DILLIS
Civil Design Group, Inc.
CIVIL ENGINEERS • LAND SURVEYORS • WETLAND CONSULTANTS

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1.0 Project Narrative

1.1 Project Type

The proposed project includes the re-development of the existing town Senior Center located at 163 West Main Street. The proposed site will consist of a Senior Center including on-site parking, a garden area, an on-site septic system and a stormwater drainage system.

1.2 Purpose and Scope

This report has been prepared to comply with the requirements of the Stormwater Management Standards incorporated in the Massachusetts Wetlands Protection Act Regulations, 310 CMR 10.00. These standards are intended to promote increased groundwater recharge and prevent stormwater discharges from causing or contributing to the pollution of surface waters and ground waters of the Commonwealth. The standards aim to accomplish these goals by encouraging the greater use of low impact development techniques and improving the operation and maintenance of stormwater best management practices.

This report addresses compliance of the proposed development with each of the ten stormwater standards, it provides calculations to support the compliance information, and it provides a Long-Term Pollution Prevention Plan and an Operation and Maintenance Plan for the stormwater management system.

1.3 Proposed Development

As mentioned, the proposed project is the re-development of the existing town Senior Center. The lot will be designed to accommodate a 10,917 square foot Senior Center with on-site parking. The site currently has access to municipal water and gas which will be used to service the building.

1.4 LID Measures

Care has been taken to lay out the proposed site in a manner that works with existing topography. BMPs such as underground infiltration systems are used to manage the stormwater runoff. Stormwater from the impervious areas of the proposed parking lot are routed to subsurface isolator chambers for pretreatment and then to a second set of infiltration chambers. The underground infiltration systems will be used to promote groundwater recharge and limit the runoff.

1.5 Site Description

The property is approximately 5.02 acres and is located on the northern side of West Main Street. Wrangling Brook runs through a portion of the property to the

west and is traveling from north to south. A Bordering Vegetated Wetland surrounds Wrangling Brook.

The site has an existing building (which is used as the current Senior Center) and associated parking area with undeveloped woodland closure towards the wetland. The topography of the site is relatively flat with slopes that are generally mild with steeper slopes along the wetlands and Wrangling Brook on the western portion of the property.

Natural Resource Conservation Service (NRCS) soils information can be found in Appendix C. The NRCS soil survey information indicates that the majority of the site is underlain by soils classified as belonging to Hydrologic Soil Group A.

1.6 Proposed Stormwater Management System

Runoff from the proposed development will be conveyed and treated through a combination of Best Management Practices (BMP's). The following is a brief discussion of each conveyance and treatment BMP proposed.

Deep Sump Hooded Catch Basins

Deep sump hooded catch basins are proposed to convey the runoff from the proposed roadway to the subsurface infiltration systems. These catch basins will discharge to manholes and conventional storm drains.

Subsurface Infiltration System

Subsurface infiltration systems are included on both the north and east sides of the parking lot. Cultec pre-fabricated chambers, model R-902HD, will be installed to collect the run off from the roofs and pavement after pretreatment in the deep sump hooded catch basins. The infiltration system will provide recharge for the groundwater as well.

1.7 Methods of Analysis

United States Department of Agriculture Natural Resources Conservation Service (NRCS) soil cover complex methods (TR-20) were employed to compute runoff quantities for the subject property and, where appropriate, adjacent property that drains toward a common discharge point with runoff from the subject site. HydroCAD 10.0 computer software was employed in this hydrologic analysis. A comparison of pre- and post-development runoff quantities at various analysis points downstream around the site was performed in order to design a stormwater management system that will limit peak rates of runoff from the development to predevelopment levels for 24-hour rainfall events of 2-, 10-, 25- and 100-year return frequencies. Watershed boundaries for existing conditions are depicted on

the attached Predevelopment Watershed Plan. Post-Developed watershed boundaries are indicated on the Post-Development Watershed Plan.

All stormwater runoff on site drains towards the existing wetlands. Therefore, one design point was used in the comparison of pre- and post-developed peak runoff rates.

2.0 Stormwater Standards Compliance

2.1 Standard 1 – Untreated Discharges

The stormwater management system for the proposed development will not result in any new discharges of untreated stormwater to wetland resource areas. Stormwater management structures have been designed such that there is no erosion or scour to wetland resource areas or waters of the Commonwealth.

2.2 Standard 2 – Peak Rate Attenuation

The stormwater management system for the proposed development will employ infiltration chambers that have been sized to retain and recharge the runoff related to a 100-year, 24-hour rainfall event.

Hydrologic calculations for existing and proposed site conditions are included in Appendices D and E respectively. Calculations for 24-hour rainfall events of 2-, 10-, 25- and 100-year return frequencies are provided. The following table provides a summary of peak rates of runoff related to each of these storms for a design point at the existing wetlands on the western side toward which all runoff from the subject property will flow. For all rainfall events considered, the proposed stormwater management system will control runoff from the development such that corresponding peak flows at the design point will not exceed predevelopment levels.

Table 1: Existing Wetlands Design Point Peak Runoff Rates

	Pre-Developed	**Post-Developed**
2-year	1.05 cfs	0.67 cfs
10-year	1.59 cfs	1.02 cfs
25-year	1.89 cfs	1.22 cfs
100-year	2.46 cfs	1.67 cfs

2.3 Standard 3 – Recharge

As discussed in the Introduction, Natural Resource Conservation Service data indicates that the areas within the proposed development consist of soils from Hydrologic group A.

Approximately 1.1 acres of the proposed development will contain impervious areas. Therefore, two stormwater infiltration areas have been designed to provide infiltration of the required recharge and water quality volumes. The proposed infiltration areas are within 4 feet of the seasonal high groundwater which requires mounding calculations to be completed. The recharge and mounding calculations can be found in Appendix F.

2.4 Standard 4 – Water Quality

A total of 85% TSS removal was achieved using BMPs. As part of the proposed project, infiltration requires a minimum of 44% TSS removal provided prior to discharge. Two TSS calculation sheets have been provided. The sheet with a deep sump catch basin into a sediment forebay shows proper pre-treatment before entering the infiltration chambers. The isolator row within the infiltration chambers will act as the sediment forebay. The sheet with deep sump catch basin into a subsurface infiltration structure shows there is enough TSS removal within the whole system. See Appendix F for detailed calculations.

2.5 Standard 5 – Land Uses with Higher Pollutant Loads

The current and proposed uses of the subject site do not constitute land use with higher potential pollutant load, thus Standard 5 does not apply to the proposed project.

2.6 Standard 6 – Critical Areas

The proposed project does not involve a stormwater discharge within or near to any of the areas defined as "Critical Areas" at 314 CMR 9.02 and 310 CMR 10.04.

2.7 Standard 7 – Redevelopment

A portion of the proposed project qualifies for redevelopment provisions however the drainage system has been designed in full compliance with the Stormwater Management Standards.

2.8 Standard 8 – Construction Period Pollution Prevention and Erosion and Sediment Control

Because the project is subject to the filing of an Environmental Protection Agency Notice of Intent (EPA NOI), the Stormwater Pollution Prevention Plan (SWPPP) will be prepared prior to construction. This document will be prepared to satisfy the requirements of the EPA NOI and the Standard 8 Construction Period Pollution prevention and Erosion and Sedimentation Control Plan.

2.9 Standard 9 – Operation and Maintenance Plan

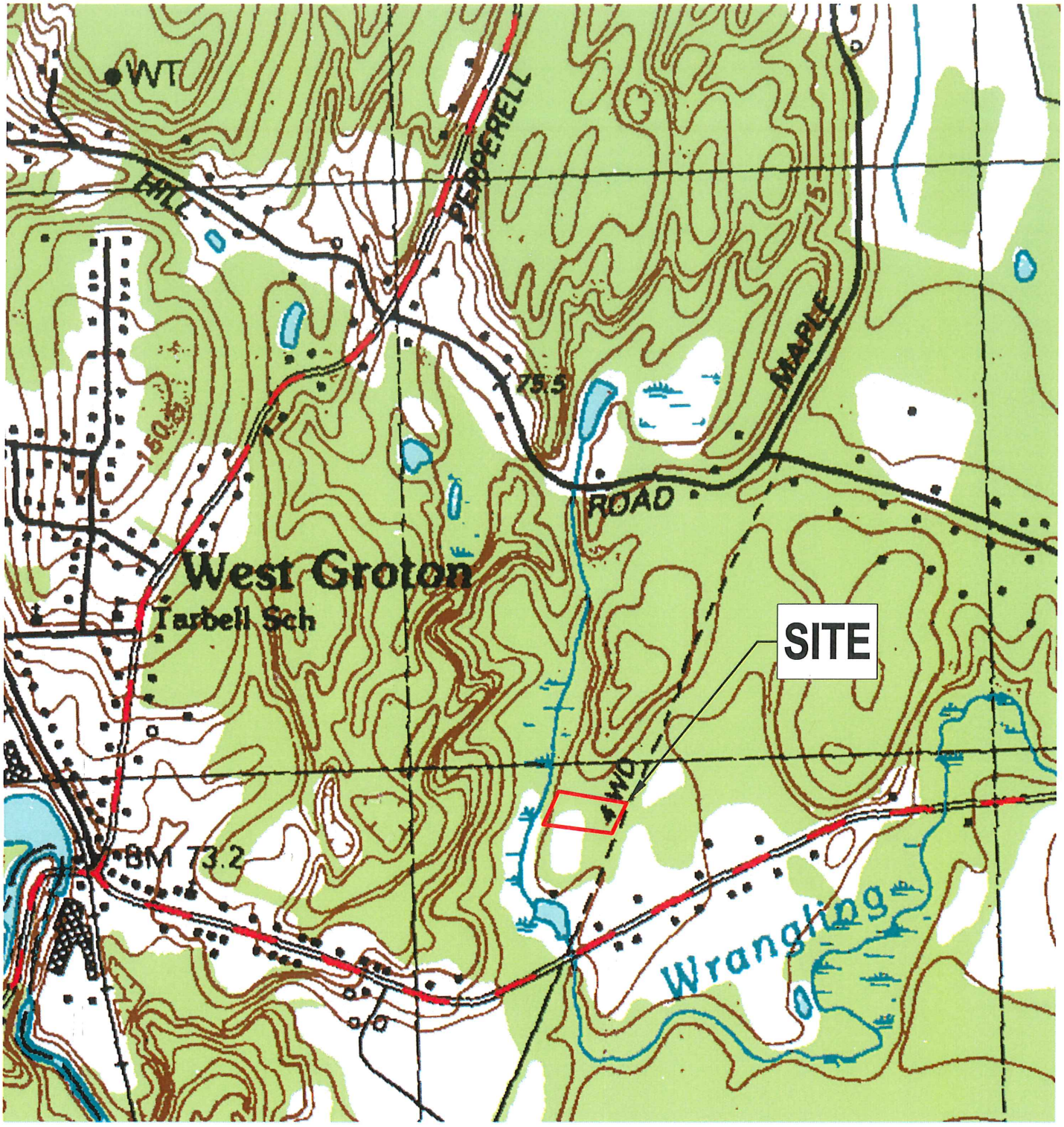
Refer to Appendix H for a complete copy of the Stormwater Operation and Maintenance Plan.

2.10 Standard 10 – Prohibition of Illicit Discharges

An illicit discharge statement will be prepared after approvals are received and prior to construction.

APPENDIX A

Locus Map



LOCUS MAP

Prepared By: Ducharme & Dillis, Civil Design Group, Inc.
1092 Main Street
P.O. Box 428
Bolton, Massachusetts

DATE: JANUARY 2018

Prepared For: Town of Groton
173 Main Street
Groton, Massachusetts

SCALE: 1" = 800'

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APPENDIX B

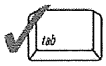
Checklist for Stormwater Report Checklist

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

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[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

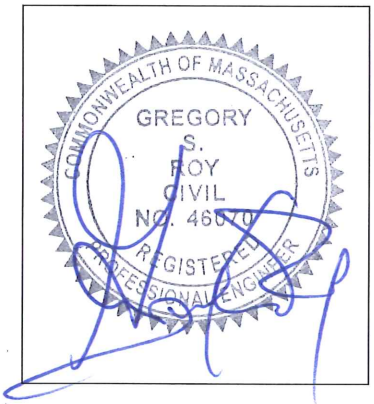
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



Signature and Date 2/9/18

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

- ☐ New development
- ☑ Redevelopment (Although the project is considered redevelopment, it meets all of the Standards below)
- ☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- [x] No disturbance to any Wetland Resource Areas
- [ ] Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- [ ] Reduced Impervious Area (Redevelopment Only)
- [ ] Minimizing disturbance to existing trees and shrubs
- [ ] LID Site Design Credit Requested:
  - [ ] Credit 1
  - [ ] Credit 2
  - [ ] Credit 3
- [ ] Use of "country drainage" versus curb and gutter conveyance and pipe
- [ ] Bioretention Cells (includes Rain Gardens)
- [ ] Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- [ ] Treebox Filter
- [ ] Water Quality Swale
- [ ] Grass Channel
- [ ] Green Roof
- [x] Other (describe): Subsurface Infiltration

Standard 1: No New Untreated Discharges

- [x] No new untreated discharges
- [x] Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- [ ] Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☑ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☑ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☑ Soil Analysis provided.

☑ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☑ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☑ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☑ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☑ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☑ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☑ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☑ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☑ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☑ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☑ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☑ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☑ The BMP is sized (and calculations provided) based on:

- ☑ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☑ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☑ Redevelopment Project (The project is in full compliance so no redevelopment checklist is provided)
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☑ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☑ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☑ Name of the stormwater management system owners;
- ☑ Party responsible for operation and maintenance;
- ☑ Schedule for implementation of routine and non-routine maintenance tasks;
- ☑ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☑ Description and delineation of public safety features;
- ☑ Estimated operation and maintenance budget; and
- ☑ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

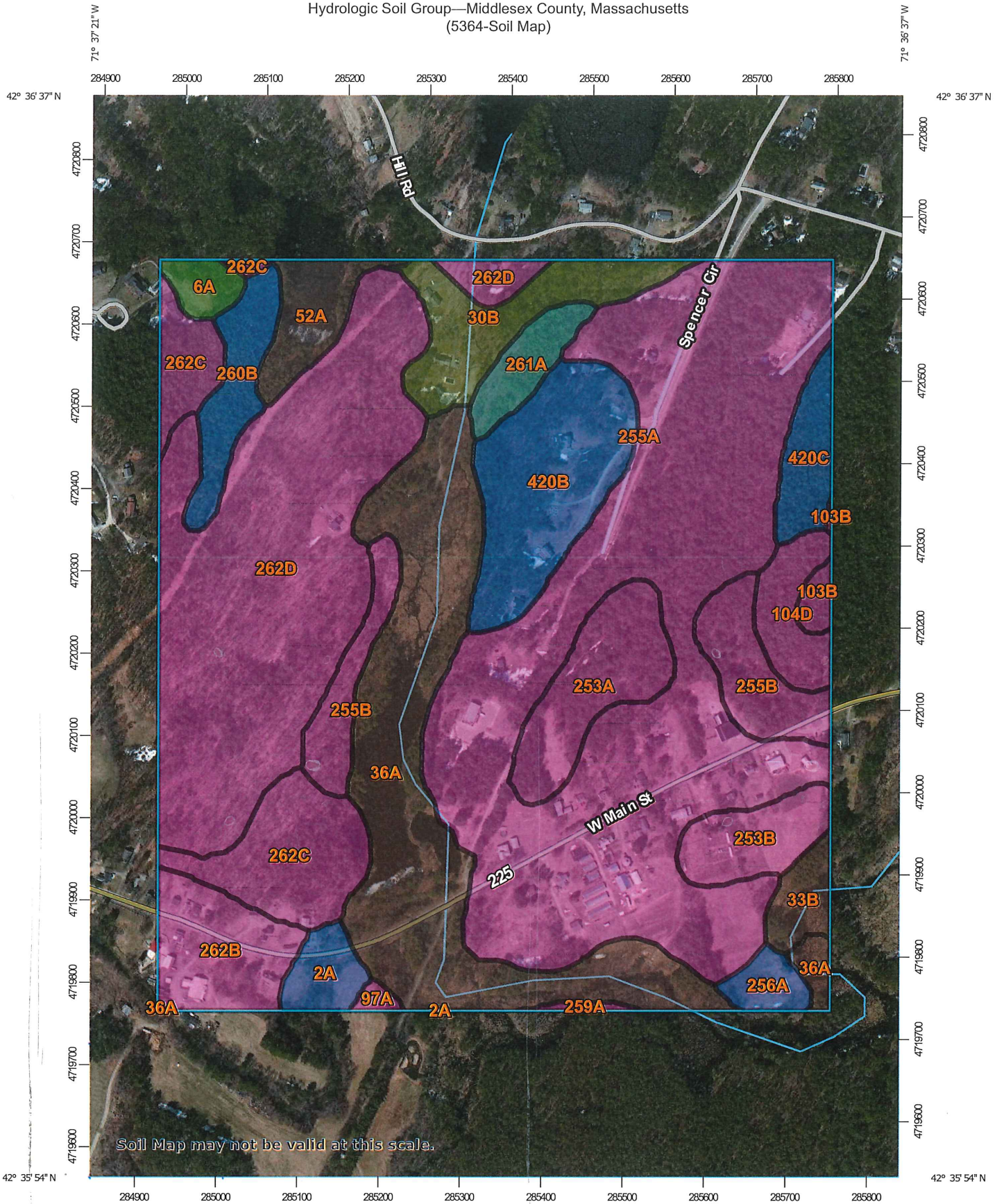
☐ An Illicit Discharge Compliance Statement is attached;

☑ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

APPENDIX C

NRCS Soils Data

Hydrologic Soil Group—Middlesex County, Massachusetts
(5364-Soil Map)



Map Scale: 1:6,410 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 17, Oct 6, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 8, 2011—Apr 9, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
2A	Pootatuck fine sandy loam, 0 to 3 percent slopes	B	2.1	1.1%
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	A/D	1.4	0.7%
30B	Raynham silt loam, 0 to 5 percent slopes	C/D	6.2	3.3%
33B	Raypol silt loam, 0 to 5 percent slopes	B/D	1.9	1.0%
36A	Saco mucky silt loam, 0 to 1 percent slopes	B/D	24.8	13.3%
52A	Freetown muck, 0 to 1 percent slopes	B/D	3.3	1.8%
97A	Suncook loamy sand, 0 to 3 percent slopes	A	0.4	0.2%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	A	0.8	0.4%
104D	Hollis-Rock outcrop-Charlton complex, 15 to 25 percent slopes	A	3.1	1.6%
253A	Hinckley loamy sand, 0 to 3 percent slopes	A	6.2	3.3%
253B	Hinckley loamy sand, 3 to 8 percent slopes	A	3.7	2.0%
255A	Windsor loamy sand, 0 to 3 percent slopes	A	55.6	29.7%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	7.2	3.9%
256A	Deerfield loamy sand, 0 to 3 percent slopes	B	1.5	0.8%
259A	Carver loamy coarse sand, 0 to 3 percent slopes	A	0.3	0.2%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	B	3.9	2.1%
261A	Tisbury silt loam, 0 to 3 percent slopes	C	2.5	1.3%
262B	Quonset sandy loam, 3 to 8 percent slopes	A	5.8	3.1%
262C	Quonset sandy loam, 8 to 15 percent slopes	A	9.4	5.0%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
262D	Quonset sandy loam, 15 to 25 percent slopes	A	33.9	18.1%
420B	Canton fine sandy loam, 3 to 8 percent slopes	B	10.3	5.5%
420C	Canton fine sandy loam, 8 to 15 percent slopes	B	2.9	1.5%
Totals for Area of Interest			**187.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

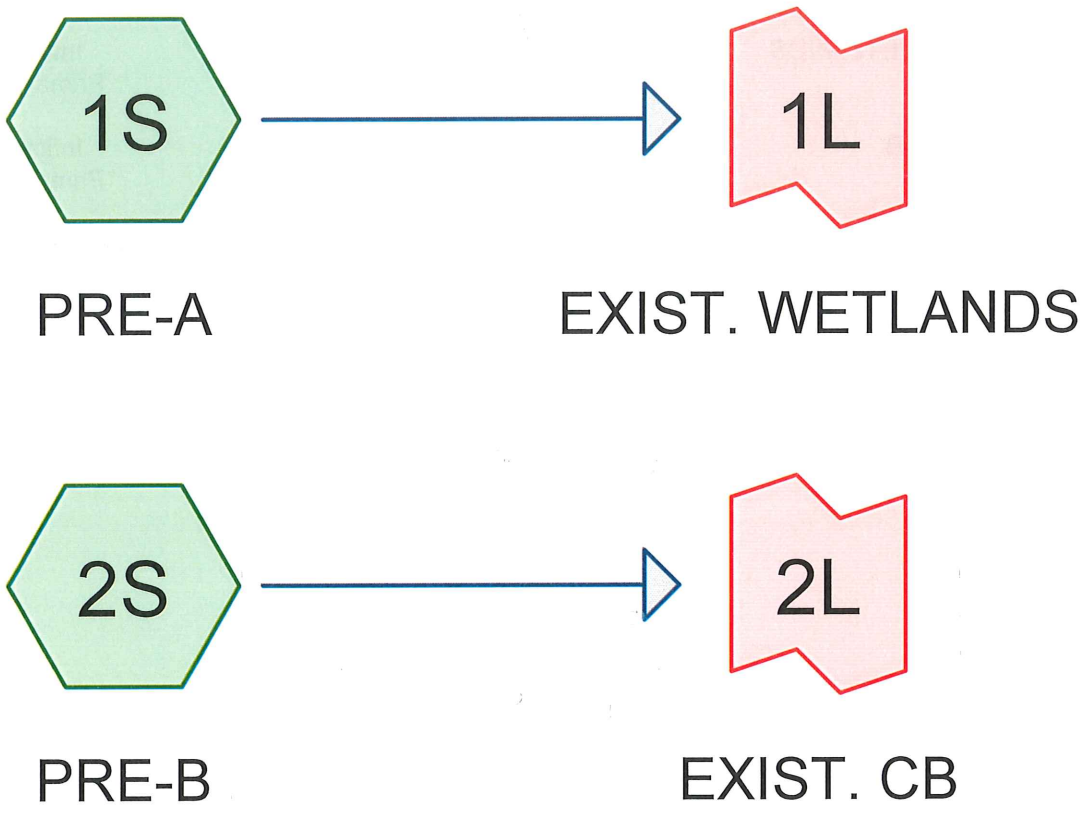
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX D

Existing Conditions – Hydrologic Calculations



Subcat Reach Pond Link

Routing Diagram for 5364-PRE
Prepared by Microsoft, Printed 1/30/2018

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: PRE-A Runoff Area=223,797 sf 10.22% Impervious Runoff Depth=0.30"
Flow Length=358' Tc=22.8 min CN=WQ Runoff=1.05 cfs 0.130 af

Subcatchment 2S: PRE-B Runoff Area=20,217 sf 56.64% Impervious Runoff Depth=1.60"
Tc=6.0 min CN=WQ Runoff=0.76 cfs 0.062 af

Link 1L: EXIST. WETLANDS Inflow=1.05 cfs 0.130 af
Primary=1.05 cfs 0.130 af

Link 2L: EXIST. CB Inflow=0.76 cfs 0.062 af
Primary=0.76 cfs 0.062 af

Total Runoff Area = 5.602 ac Runoff Volume = 0.192 af Average Runoff Depth = 0.41"
85.93% Pervious = 4.814 ac 14.07% Impervious = 0.788 ac

Summary for Subcatchment 1S: PRE-A

Runoff = 1.05 cfs @ 12.30 hrs, Volume= 0.130 af, Depth= 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr 24hr Rainfall=3.05"

Area (sf)	CN	Description
16,967	98	Paved parking, HSG A
3,215	76	Gravel roads, HSG A
64,839	39	>75% Grass cover, Good, HSG A
132,865	30	Woods, Good, HSG A
5,911	98	Roofs, HSG A
223,797		Weighted Average
200,919		89.78% Pervious Area
22,878		10.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
6.1	308	0.0280	0.84		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
22.8	358	Total			

Summary for Subcatchment 2S: PRE-B

Runoff = 0.76 cfs @ 12.09 hrs, Volume= 0.062 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr 24hr Rainfall=3.05"

Area (sf)	CN	Description
11,450	98	Paved parking, HSG A
4,076	39	>75% Grass cover, Good, HSG A
4,691	30	Woods, Good, HSG A
20,217		Weighted Average
8,767		43.36% Pervious Area
11,450		56.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Link 1L: EXIST. WETLANDS

Inflow Area = 5.138 ac, 10.22% Impervious, Inflow Depth = 0.30" for 2yr 24hr event
Inflow = 1.05 cfs @ 12.30 hrs, Volume= 0.130 af
Primary = 1.05 cfs @ 12.30 hrs, Volume= 0.130 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link 2L: EXIST. CB

Inflow Area = 0.464 ac, 56.64% Impervious, Inflow Depth = 1.60" for 2yr 24hr event
Inflow = 0.76 cfs @ 12.09 hrs, Volume= 0.062 af
Primary = 0.76 cfs @ 12.09 hrs, Volume= 0.062 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: PRE-A Runoff Area=223,797 sf 10.22% Impervious Runoff Depth=0.49"
Flow Length=358' Tc=22.8 min CN=WQ Runoff=1.59 cfs 0.210 af

Subcatchment 2S: PRE-B Runoff Area=20,217 sf 56.64% Impervious Runoff Depth=2.41"
Tc=6.0 min CN=WQ Runoff=1.12 cfs 0.093 af

Link 1L: EXIST. WETLANDS Inflow=1.59 cfs 0.210 af
Primary=1.59 cfs 0.210 af

Link 2L: EXIST. CB Inflow=1.12 cfs 0.093 af
Primary=1.12 cfs 0.093 af

Total Runoff Area = 5.602 ac Runoff Volume = 0.303 af Average Runoff Depth = 0.65"
85.93% Pervious = 4.814 ac 14.07% Impervious = 0.788 ac

Summary for Subcatchment 1S: PRE-A

Runoff = 1.59 cfs @ 12.30 hrs, Volume= 0.210 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr 24hr Rainfall=4.45"

Area (sf)	CN	Description
16,967	98	Paved parking, HSG A
3,215	76	Gravel roads, HSG A
64,839	39	>75% Grass cover, Good, HSG A
132,865	30	Woods, Good, HSG A
5,911	98	Roofs, HSG A
223,797		Weighted Average
200,919		89.78% Pervious Area
22,878		10.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
6.1	308	0.0280	0.84		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
22.8	358	Total			

Summary for Subcatchment 2S: PRE-B

Runoff = 1.12 cfs @ 12.09 hrs, Volume= 0.093 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr 24hr Rainfall=4.45"

Area (sf)	CN	Description
11,450	98	Paved parking, HSG A
4,076	39	>75% Grass cover, Good, HSG A
4,691	30	Woods, Good, HSG A
20,217		Weighted Average
8,767		43.36% Pervious Area
11,450		56.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Link 1L: EXIST. WETLANDS

Inflow Area = 5.138 ac, 10.22% Impervious, Inflow Depth = 0.49" for 10yr 24hr event
Inflow = 1.59 cfs @ 12.30 hrs, Volume= 0.210 af
Primary = 1.59 cfs @ 12.30 hrs, Volume= 0.210 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link 2L: EXIST. CB

Inflow Area = 0.464 ac, 56.64% Impervious, Inflow Depth = 2.41" for 10yr 24hr event
Inflow = 1.12 cfs @ 12.09 hrs, Volume= 0.093 af
Primary = 1.12 cfs @ 12.09 hrs, Volume= 0.093 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: PRE-A Runoff Area=223,797 sf 10.22% Impervious Runoff Depth=0.63"
Flow Length=358' Tc=22.8 min CN=WQ Runoff=1.89 cfs 0.271 af

Subcatchment 2S: PRE-B Runoff Area=20,217 sf 56.64% Impervious Runoff Depth=2.89"
Tc=6.0 min CN=WQ Runoff=1.32 cfs 0.112 af

Link 1L: EXIST. WETLANDS Inflow=1.89 cfs 0.271 af
Primary=1.89 cfs 0.271 af

Link 2L: EXIST. CB Inflow=1.32 cfs 0.112 af
Primary=1.32 cfs 0.112 af

Total Runoff Area = 5.602 ac Runoff Volume = 0.383 af Average Runoff Depth = 0.82"
85.93% Pervious = 4.814 ac 14.07% Impervious = 0.788 ac

Summary for Subcatchment 1S: PRE-A

Runoff = 1.89 cfs @ 12.30 hrs, Volume= 0.271 af, Depth= 0.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr 24hr Rainfall=5.25"

Area (sf)	CN	Description
16,967	98	Paved parking, HSG A
3,215	76	Gravel roads, HSG A
64,839	39	>75% Grass cover, Good, HSG A
132,865	30	Woods, Good, HSG A
5,911	98	Roofs, HSG A
223,797		Weighted Average
200,919		89.78% Pervious Area
22,878		10.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
6.1	308	0.0280	0.84		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
22.8	358	Total			

Summary for Subcatchment 2S: PRE-B

Runoff = 1.32 cfs @ 12.09 hrs, Volume= 0.112 af, Depth= 2.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr 24hr Rainfall=5.25"

Area (sf)	CN	Description
11,450	98	Paved parking, HSG A
4,076	39	>75% Grass cover, Good, HSG A
4,691	30	Woods, Good, HSG A
20,217		Weighted Average
8,767		43.36% Pervious Area
11,450		56.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Link 1L: EXIST. WETLANDS

Inflow Area = 5.138 ac, 10.22% Impervious, Inflow Depth = 0.63" for 25yr 24hr event
Inflow = 1.89 cfs @ 12.30 hrs, Volume= 0.271 af
Primary = 1.89 cfs @ 12.30 hrs, Volume= 0.271 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link 2L: EXIST. CB

Inflow Area = 0.464 ac, 56.64% Impervious, Inflow Depth = 2.89" for 25yr 24hr event
Inflow = 1.32 cfs @ 12.09 hrs, Volume= 0.112 af
Primary = 1.32 cfs @ 12.09 hrs, Volume= 0.112 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: PRE-A Runoff Area=223,797 sf 10.22% Impervious Runoff Depth=0.90"
Flow Length=358' Tc=22.8 min CN=WQ Runoff=2.46 cfs 0.387 af

Subcatchment 2S: PRE-B Runoff Area=20,217 sf 56.64% Impervious Runoff Depth=3.60"
Tc=6.0 min CN=WQ Runoff=1.61 cfs 0.139 af

Link 1L: EXIST. WETLANDS Inflow=2.46 cfs 0.387 af
Primary=2.46 cfs 0.387 af

Link 2L: EXIST. CB Inflow=1.61 cfs 0.139 af
Primary=1.61 cfs 0.139 af

Total Runoff Area = 5.602 ac Runoff Volume = 0.526 af Average Runoff Depth = 1.13"
85.93% Pervious = 4.814 ac 14.07% Impervious = 0.788 ac

Summary for Subcatchment 1S: PRE-A

Runoff = 2.46 cfs @ 12.32 hrs, Volume= 0.387 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr 24hr Rainfall=6.35"

Area (sf)	CN	Description
16,967	98	Paved parking, HSG A
3,215	76	Gravel roads, HSG A
64,839	39	>75% Grass cover, Good, HSG A
132,865	30	Woods, Good, HSG A
5,911	98	Roofs, HSG A
223,797		Weighted Average
200,919		89.78% Pervious Area
22,878		10.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
6.1	308	0.0280	0.84		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
22.8	358	Total			

Summary for Subcatchment 2S: PRE-B

Runoff = 1.61 cfs @ 12.09 hrs, Volume= 0.139 af, Depth= 3.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr 24hr Rainfall=6.35"

Area (sf)	CN	Description
11,450	98	Paved parking, HSG A
4,076	39	>75% Grass cover, Good, HSG A
4,691	30	Woods, Good, HSG A
20,217		Weighted Average
8,767		43.36% Pervious Area
11,450		56.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Link 1L: EXIST. WETLANDS

Inflow Area = 5.138 ac, 10.22% Impervious, Inflow Depth = 0.90" for 100yr 24hr event
Inflow = 2.46 cfs @ 12.32 hrs, Volume= 0.387 af
Primary = 2.46 cfs @ 12.32 hrs, Volume= 0.387 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

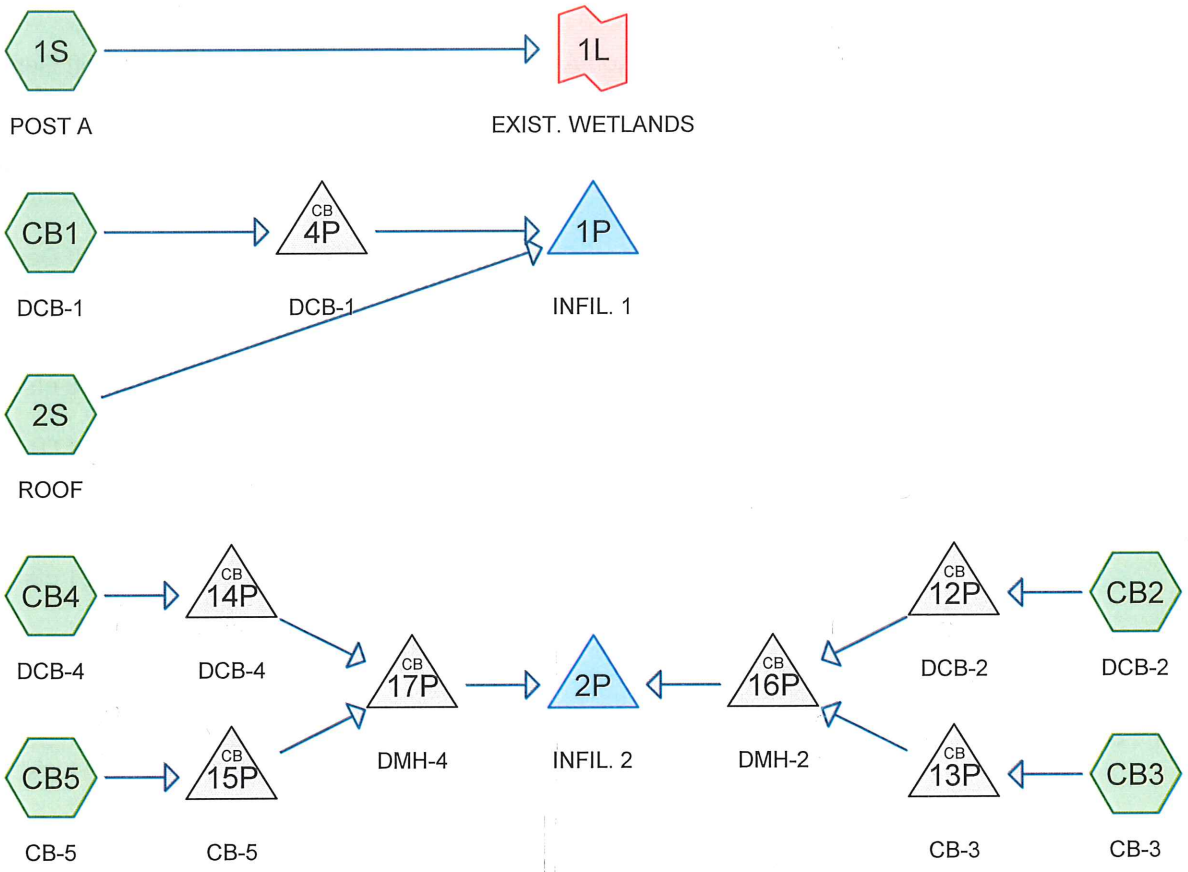
Summary for Link 2L: EXIST. CB

Inflow Area = 0.464 ac, 56.64% Impervious, Inflow Depth = 3.60" for 100yr 24hr event
Inflow = 1.61 cfs @ 12.09 hrs, Volume= 0.139 af
Primary = 1.61 cfs @ 12.09 hrs, Volume= 0.139 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

APPENDIX E

Proposed Conditions – Hydrologic Calculations



Subcat Reach Pond Link

Routing Diagram for 5364-POST
Prepared by Microsoft, Printed 1/30/2018

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: POST A Runoff Area=192,152 sf 7.31% Impervious Runoff Depth=0.22"
Flow Length=358' Tc=22.8 min CN=WQ Runoff=0.67 cfs 0.082 af

Subcatchment 2S: ROOF Runoff Area=10,991 sf 100.00% Impervious Runoff Depth=2.82"
Tc=6.0 min CN=98 Runoff=0.73 cfs 0.059 af

Subcatchment CB1: DCB-1 Runoff Area=8,766 sf 87.96% Impervious Runoff Depth=2.48"
Tc=6.0 min CN=WQ Runoff=0.51 cfs 0.042 af

Subcatchment CB2: DCB-2 Runoff Area=9,742 sf 95.31% Impervious Runoff Depth=2.69"
Tc=6.0 min CN=WQ Runoff=0.62 cfs 0.050 af

Subcatchment CB3: CB-3 Runoff Area=5,444 sf 84.40% Impervious Runoff Depth=2.38"
Tc=6.0 min CN=WQ Runoff=0.30 cfs 0.025 af

Subcatchment CB4: DCB-4 Runoff Area=11,066 sf 92.63% Impervious Runoff Depth=2.61"
Tc=6.0 min CN=WQ Runoff=0.68 cfs 0.055 af

Subcatchment CB5: CB-5 Runoff Area=5,857 sf 89.12% Impervious Runoff Depth=2.51"
Tc=6.0 min CN=WQ Runoff=0.35 cfs 0.028 af

Pond 1P: INFIL. 1 Peak Elev=216.43' Storage=0.024 af Inflow=1.24 cfs 0.101 af
Outflow=0.31 cfs 0.101 af

Pond 2P: INFIL. 2 Peak Elev=216.51' Storage=0.038 af Inflow=1.95 cfs 0.158 af
Outflow=0.48 cfs 0.158 af

Pond 4P: DCB-1 Peak Elev=218.09' Inflow=0.51 cfs 0.042 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0100 '/' Outflow=0.51 cfs 0.042 af

Pond 12P: DCB-2 Peak Elev=216.74' Inflow=0.62 cfs 0.050 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0160 '/' Outflow=0.62 cfs 0.050 af

Pond 13P: CB-3 Peak Elev=216.56' Inflow=0.30 cfs 0.025 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0120 '/' Outflow=0.30 cfs 0.025 af

Pond 14P: DCB-4 Peak Elev=217.81' Inflow=0.68 cfs 0.055 af
12.0" Round Culvert n=0.013 L=12.0' S=0.0200 '/' Outflow=0.68 cfs 0.055 af

Pond 15P: CB-5 Peak Elev=216.72' Inflow=0.35 cfs 0.028 af
12.0" Round Culvert n=0.013 L=28.0' S=0.0100 '/' Outflow=0.35 cfs 0.028 af

Pond 16P: DMH-2 Peak Elev=216.59' Inflow=0.92 cfs 0.075 af
12.0" Round Culvert n=0.013 L=36.0' S=0.0100 '/' Outflow=0.92 cfs 0.075 af

Pond 17P: DMH-4 Peak Elev=216.61' Inflow=1.03 cfs 0.083 af
12.0" Round Culvert n=0.013 L=34.0' S=0.0100 '/' Outflow=1.03 cfs 0.083 af

Link 1L: EXIST. WETLANDS

Inflow=0.67 cfs 0.082 af
Primary=0.67 cfs 0.082 af

Total Runoff Area = 5.602 ac Runoff Volume = 0.341 af Average Runoff Depth = 0.73"
74.56% Pervious = 4.176 ac 25.44% Impervious = 1.425 ac

Summary for Subcatchment 1S: POST A

Runoff = 0.67 cfs @ 12.30 hrs, Volume= 0.082 af, Depth= 0.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr 24hr Rainfall=3.05"

Area (sf)	CN	Description
11,556	98	Paved parking, HSG A
3,214	76	Gravel roads, HSG A
73,451	39	>75% Grass cover, Good, HSG A
101,449	30	Woods, Good, HSG A
2,482	98	Roofs, HSG A
192,152		Weighted Average
178,114	35	92.69% Pervious Area
14,038	98	7.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
6.1	308	0.0280	0.84		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
22.8	358	Total			

Summary for Subcatchment 2S: ROOF

Runoff = 0.73 cfs @ 12.09 hrs, Volume= 0.059 af, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr 24hr Rainfall=3.05"

Area (sf)	CN	Description
10,991	98	Roofs, HSG A
10,991	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB1: DCB-1

Runoff = 0.51 cfs @ 12.09 hrs, Volume= 0.042 af, Depth= 2.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr 24hr Rainfall=3.05"

Area (sf)	CN	Description
7,711	98	Paved parking, HSG A
1,055	39	>75% Grass cover, Good, HSG A
8,766		Weighted Average
1,055	39	12.04% Pervious Area
7,711	98	87.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB2: DCB-2

Runoff = 0.62 cfs @ 12.09 hrs, Volume= 0.050 af, Depth= 2.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr 24hr Rainfall=3.05"

Area (sf)	CN	Description
9,285	98	Paved parking, HSG A
457	39	>75% Grass cover, Good, HSG A
9,742		Weighted Average
457	39	4.69% Pervious Area
9,285	98	95.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB3: CB-3

Runoff = 0.30 cfs @ 12.09 hrs, Volume= 0.025 af, Depth= 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr 24hr Rainfall=3.05"

Area (sf)	CN	Description
4,595	98	Paved parking, HSG A
849	39	>75% Grass cover, Good, HSG A
5,444		Weighted Average
849	39	15.60% Pervious Area
4,595	98	84.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB4: DCB-4

Runoff = 0.68 cfs @ 12.09 hrs, Volume= 0.055 af, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr 24hr Rainfall=3.05"

Area (sf)	CN	Description
10,250	98	Paved parking, HSG A
816	39	>75% Grass cover, Good, HSG A
11,066		Weighted Average
816	39	7.37% Pervious Area
10,250	98	92.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB5: CB-5

Runoff = 0.35 cfs @ 12.09 hrs, Volume= 0.028 af, Depth= 2.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr 24hr Rainfall=3.05"

Area (sf)	CN	Description
5,220	98	Paved parking, HSG A
637	39	>75% Grass cover, Good, HSG A
5,857		Weighted Average
637	39	10.88% Pervious Area
5,220	98	89.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Pond 1P: INFIL. 1

Inflow Area = 0.454 ac, 94.66% Impervious, Inflow Depth = 2.67" for 2yr 24hr event
Inflow = 1.24 cfs @ 12.09 hrs, Volume= 0.101 af
Outflow = 0.31 cfs @ 12.46 hrs, Volume= 0.101 af, Atten= 75%, Lag= 22.3 min
Discarded = 0.31 cfs @ 12.46 hrs, Volume= 0.101 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.43' @ 12.46 hrs Surf.Area= 0.019 ac Storage= 0.024 af
Flood Elev= 220.25' Surf.Area= 0.019 ac Storage= 0.068 af

Plug-Flow detention time= 20.5 min calculated for 0.101 af (100% of inflow)
Center-of-Mass det. time= 20.5 min (777.9 - 757.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	214.50'	0.028 af	**23.00'W x 36.03'L x 5.75'H Field A** 0.109 af Overall - 0.041 af Embedded = 0.069 af x 40.0% Voids
#2A	215.25'	0.041 af	**Cultec R-902HD** x 27 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 3 Rows of 9 Chambers Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		0.068 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	214.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 212.50'

Discarded OutFlow Max=0.31 cfs @ 12.46 hrs HW=216.43' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.31 cfs)

Summary for Pond 2P: INFIL. 2

Inflow Area = 0.737 ac, 91.41% Impervious, Inflow Depth = 2.58" for 2yr 24hr event
Inflow = 1.95 cfs @ 12.09 hrs, Volume= 0.158 af
Outflow = 0.48 cfs @ 12.46 hrs, Volume= 0.158 af, Atten= 75%, Lag= 22.6 min
Discarded = 0.48 cfs @ 12.46 hrs, Volume= 0.158 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.51' @ 12.46 hrs Surf.Area= 0.029 ac Storage= 0.038 af
Flood Elev= 220.25' Surf.Area= 0.029 ac Storage= 0.104 af

Plug-Flow detention time= 21.5 min calculated for 0.158 af (100% of inflow)
Center-of-Mass det. time= 21.5 min (778.9 - 757.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	214.50'	0.041 af	**23.00'W x 54.37'L x 5.75'H Field A** 0.165 af Overall - 0.063 af Embedded = 0.102 af x 40.0% Voids
#2A	215.25'	0.063 af	**Cultec R-902HD** x 42 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 3 Rows of 14 Chambers Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		0.104 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	214.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 212.50'

Discarded OutFlow Max=0.48 cfs @ 12.46 hrs HW=216.51' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.48 cfs)

Summary for Pond 4P: DCB-1

Inflow Area = 0.201 ac, 87.96% Impervious, Inflow Depth = 2.48" for 2yr 24hr event
Inflow = 0.51 cfs @ 12.09 hrs, Volume= 0.042 af
Outflow = 0.51 cfs @ 12.09 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.0 min
Primary = 0.51 cfs @ 12.09 hrs, Volume= 0.042 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.09' @ 12.09 hrs
Flood Elev= 220.68'

Device	Routing	Invert	Outlet Devices
#1	Primary	217.68'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.68' / 217.48' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.50 cfs @ 12.09 hrs HW=218.08' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.50 cfs @ 1.70 fps)

Summary for Pond 12P: DCB-2

Inflow Area = 0.224 ac, 95.31% Impervious, Inflow Depth = 2.69" for 2yr 24hr event
Inflow = 0.62 cfs @ 12.09 hrs, Volume= 0.050 af
Outflow = 0.62 cfs @ 12.09 hrs, Volume= 0.050 af, Atten= 0%, Lag= 0.0 min
Primary = 0.62 cfs @ 12.09 hrs, Volume= 0.050 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.74' @ 12.09 hrs
Flood Elev= 220.29'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.29'	**12.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.29' / 216.13' S= 0.0160 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.60 cfs @ 12.09 hrs HW=216.73' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.60 cfs @ 1.79 fps)

Summary for Pond 13P: CB-3

Inflow Area = 0.125 ac, 84.40% Impervious, Inflow Depth = 2.38" for 2yr 24hr event
Inflow = 0.30 cfs @ 12.09 hrs, Volume= 0.025 af
Outflow = 0.30 cfs @ 12.09 hrs, Volume= 0.025 af, Atten= 0%, Lag= 0.0 min
Primary = 0.30 cfs @ 12.09 hrs, Volume= 0.025 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.56' @ 12.09 hrs
Flood Elev= 220.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.25'	**12.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.25' / 216.13' S= 0.0120 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.30 cfs @ 12.09 hrs HW=216.55' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 0.30 cfs @ 2.20 fps)

Summary for Pond 14P: DCB-4

Inflow Area = 0.254 ac, 92.63% Impervious, Inflow Depth = 2.61" for 2yr 24hr event
Inflow = 0.68 cfs @ 12.09 hrs, Volume= 0.055 af
Outflow = 0.68 cfs @ 12.09 hrs, Volume= 0.055 af, Atten= 0%, Lag= 0.0 min
Primary = 0.68 cfs @ 12.09 hrs, Volume= 0.055 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 217.81' @ 12.09 hrs
Flood Elev= 220.34'

Device	Routing	Invert	Outlet Devices
#1	Primary	217.34'	**12.0" Round Culvert** L= 12.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.34' / 217.10' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.66 cfs @ 12.09 hrs HW=217.81' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.66 cfs @ 1.84 fps)

Summary for Pond 15P: CB-5

Inflow Area = 0.134 ac, 89.12% Impervious, Inflow Depth = 2.51" for 2yr 24hr event
Inflow = 0.35 cfs @ 12.09 hrs, Volume= 0.028 af
Outflow = 0.35 cfs @ 12.09 hrs, Volume= 0.028 af, Atten= 0%, Lag= 0.0 min
Primary = 0.35 cfs @ 12.09 hrs, Volume= 0.028 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.72' @ 12.09 hrs
Flood Elev= 219.39'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.39'	**12.0" Round Culvert** L= 28.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.39' / 216.11' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.34 cfs @ 12.09 hrs HW=216.71' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.34 cfs @ 1.53 fps)

Summary for Pond 16P: DMH-2

Inflow Area = 0.349 ac, 91.40% Impervious, Inflow Depth = 2.58" for 2yr 24hr event
Inflow = 0.92 cfs @ 12.09 hrs, Volume= 0.075 af
Outflow = 0.92 cfs @ 12.09 hrs, Volume= 0.075 af, Atten= 0%, Lag= 0.0 min
Primary = 0.92 cfs @ 12.09 hrs, Volume= 0.075 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.59' @ 12.09 hrs
Flood Elev= 220.24'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.03'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.03' / 215.67' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.89 cfs @ 12.09 hrs HW=216.58' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.89 cfs @ 2.00 fps)

Summary for Pond 17P: DMH-4

Inflow Area = 0.388 ac, 91.41% Impervious, Inflow Depth = 2.58" for 2yr 24hr event
Inflow = 1.03 cfs @ 12.09 hrs, Volume= 0.083 af
Outflow = 1.03 cfs @ 12.09 hrs, Volume= 0.083 af, Atten= 0%, Lag= 0.0 min
Primary = 1.03 cfs @ 12.09 hrs, Volume= 0.083 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.61' @ 12.09 hrs
Flood Elev= 220.13'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.01'	**12.0" Round Culvert** L= 34.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.01' / 215.67' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.00 cfs @ 12.09 hrs HW=216.60' (Free Discharge)
↑**1=Culvert** (Inlet Controls 1.00 cfs @ 2.07 fps)

Summary for Link 1L: EXIST. WETLANDS

Inflow Area = 4.411 ac, 7.31% Impervious, Inflow Depth = 0.22" for 2yr 24hr event
Inflow = 0.67 cfs @ 12.30 hrs, Volume= 0.082 af
Primary = 0.67 cfs @ 12.30 hrs, Volume= 0.082 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: POST A Runoff Area=192,152 sf 7.31% Impervious Runoff Depth=0.38"
Flow Length=358' Tc=22.8 min CN=WQ Runoff=1.02 cfs 0.140 af

Subcatchment 2S: ROOF Runoff Area=10,991 sf 100.00% Impervious Runoff Depth=4.21"
Tc=6.0 min CN=98 Runoff=1.07 cfs 0.089 af

Subcatchment CB1: DCB-1 Runoff Area=8,766 sf 87.96% Impervious Runoff Depth=3.72"
Tc=6.0 min CN=WQ Runoff=0.75 cfs 0.062 af

Subcatchment CB2: DCB-2 Runoff Area=9,742 sf 95.31% Impervious Runoff Depth=4.02"
Tc=6.0 min CN=WQ Runoff=0.90 cfs 0.075 af

Subcatchment CB3: CB-3 Runoff Area=5,444 sf 84.40% Impervious Runoff Depth=3.57"
Tc=6.0 min CN=WQ Runoff=0.45 cfs 0.037 af

Subcatchment CB4: DCB-4 Runoff Area=11,066 sf 92.63% Impervious Runoff Depth=3.91"
Tc=6.0 min CN=WQ Runoff=1.00 cfs 0.083 af

Subcatchment CB5: CB-5 Runoff Area=5,857 sf 89.12% Impervious Runoff Depth=3.77"
Tc=6.0 min CN=WQ Runoff=0.51 cfs 0.042 af

Pond 1P: INFIL. 1 Peak Elev=217.57' Storage=0.040 af Inflow=1.82 cfs 0.151 af
Outflow=0.40 cfs 0.151 af

Pond 2P: INFIL. 2 Peak Elev=217.70' Storage=0.064 af Inflow=2.86 cfs 0.237 af
Outflow=0.62 cfs 0.237 af

Pond 4P: DCB-1 Peak Elev=218.18' Inflow=0.75 cfs 0.062 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0100 '/' Outflow=0.75 cfs 0.062 af

Pond 12P: DCB-2 Peak Elev=216.85' Inflow=0.90 cfs 0.075 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0160 '/' Outflow=0.90 cfs 0.075 af

Pond 13P: CB-3 Peak Elev=216.63' Inflow=0.45 cfs 0.037 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0120 '/' Outflow=0.45 cfs 0.037 af

Pond 14P: DCB-4 Peak Elev=217.93' Inflow=1.00 cfs 0.083 af
12.0" Round Culvert n=0.013 L=12.0' S=0.0200 '/' Outflow=1.00 cfs 0.083 af

Pond 15P: CB-5 Peak Elev=216.79' Inflow=0.51 cfs 0.042 af
12.0" Round Culvert n=0.013 L=28.0' S=0.0100 '/' Outflow=0.51 cfs 0.042 af

Pond 16P: DMH-2 Peak Elev=216.74' Inflow=1.35 cfs 0.112 af
12.0" Round Culvert n=0.013 L=36.0' S=0.0100 '/' Outflow=1.35 cfs 0.112 af

Pond 17P: DMH-4 Peak Elev=216.77' Inflow=1.51 cfs 0.125 af
12.0" Round Culvert n=0.013 L=34.0' S=0.0100 '/' Outflow=1.51 cfs 0.125 af

Link 1L: EXIST. WETLANDS

Inflow=1.02 cfs 0.140 af
Primary=1.02 cfs 0.140 af

Total Runoff Area = 5.602 ac Runoff Volume = 0.529 af Average Runoff Depth = 1.13"
74.56% Pervious = 4.176 ac 25.44% Impervious = 1.425 ac

Summary for Subcatchment 1S: POST A

Runoff = 1.02 cfs @ 12.30 hrs, Volume= 0.140 af, Depth= 0.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr 24hr Rainfall=4.45"

Area (sf)	CN	Description
11,556	98	Paved parking, HSG A
3,214	76	Gravel roads, HSG A
73,451	39	>75% Grass cover, Good, HSG A
101,449	30	Woods, Good, HSG A
2,482	98	Roofs, HSG A
192,152		Weighted Average
178,114	35	92.69% Pervious Area
14,038	98	7.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
6.1	308	0.0280	0.84		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
22.8	358	Total			

Summary for Subcatchment 2S: ROOF

Runoff = 1.07 cfs @ 12.09 hrs, Volume= 0.089 af, Depth= 4.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr 24hr Rainfall=4.45"

Area (sf)	CN	Description
10,991	98	Roofs, HSG A
10,991	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB1: DCB-1

Runoff = 0.75 cfs @ 12.09 hrs, Volume= 0.062 af, Depth= 3.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr 24hr Rainfall=4.45"

Area (sf)	CN	Description
7,711	98	Paved parking, HSG A
1,055	39	>75% Grass cover, Good, HSG A
8,766		Weighted Average
1,055	39	12.04% Pervious Area
7,711	98	87.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB2: DCB-2

Runoff = 0.90 cfs @ 12.09 hrs, Volume= 0.075 af, Depth= 4.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr 24hr Rainfall=4.45"

Area (sf)	CN	Description
9,285	98	Paved parking, HSG A
457	39	>75% Grass cover, Good, HSG A
9,742		Weighted Average
457	39	4.69% Pervious Area
9,285	98	95.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB3: CB-3

Runoff = 0.45 cfs @ 12.09 hrs, Volume= 0.037 af, Depth= 3.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr 24hr Rainfall=4.45"

Area (sf)	CN	Description
4,595	98	Paved parking, HSG A
849	39	>75% Grass cover, Good, HSG A
5,444		Weighted Average
849	39	15.60% Pervious Area
4,595	98	84.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB4: DCB-4

Runoff = 1.00 cfs @ 12.09 hrs, Volume= 0.083 af, Depth= 3.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr 24hr Rainfall=4.45"

Area (sf)	CN	Description
10,250	98	Paved parking, HSG A
816	39	>75% Grass cover, Good, HSG A
11,066		Weighted Average
816	39	7.37% Pervious Area
10,250	98	92.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB5: CB-5

Runoff = 0.51 cfs @ 12.09 hrs, Volume= 0.042 af, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10yr 24hr Rainfall=4.45"

Area (sf)	CN	Description
5,220	98	Paved parking, HSG A
637	39	>75% Grass cover, Good, HSG A
5,857		Weighted Average
637	39	10.88% Pervious Area
5,220	98	89.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Pond 1P: INFIL. 1

Inflow Area = 0.454 ac, 94.66% Impervious, Inflow Depth = 3.99" for 10yr 24hr event
Inflow = 1.82 cfs @ 12.09 hrs, Volume= 0.151 af
Outflow = 0.40 cfs @ 12.49 hrs, Volume= 0.151 af, Atten= 78%, Lag= 24.2 min
Discarded = 0.40 cfs @ 12.49 hrs, Volume= 0.151 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 217.57' @ 12.49 hrs Surf.Area= 0.019 ac Storage= 0.040 af
Flood Elev= 220.25' Surf.Area= 0.019 ac Storage= 0.068 af

Plug-Flow detention time= 30.3 min calculated for 0.151 af (100% of inflow)
Center-of-Mass det. time= 30.3 min (780.7 - 750.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	214.50'	0.028 af	**23.00'W x 36.03'L x 5.75'H Field A** 0.109 af Overall - 0.041 af Embedded = 0.069 af x 40.0% Voids
#2A	215.25'	0.041 af	**Cultec R-902HD** x 27 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 3 Rows of 9 Chambers Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		0.068 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	214.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 212.50'

Discarded OutFlow Max=0.40 cfs @ 12.49 hrs HW=217.57' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.40 cfs)

Summary for Pond 2P: INFIL. 2

Inflow Area = 0.737 ac, 91.41% Impervious, Inflow Depth = 3.86" for 10yr 24hr event
Inflow = 2.86 cfs @ 12.09 hrs, Volume= 0.237 af
Outflow = 0.62 cfs @ 12.49 hrs, Volume= 0.237 af, Atten= 78%, Lag= 24.5 min
Discarded = 0.62 cfs @ 12.49 hrs, Volume= 0.237 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 217.70' @ 12.49 hrs Surf.Area= 0.029 ac Storage= 0.064 af
Flood Elev= 220.25' Surf.Area= 0.029 ac Storage= 0.104 af

Plug-Flow detention time= 31.6 min calculated for 0.237 af (100% of inflow)
Center-of-Mass det. time= 31.6 min (782.3 - 750.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	214.50'	0.041 af	**23.00'W x 54.37'L x 5.75'H Field A** 0.165 af Overall - 0.063 af Embedded = 0.102 af x 40.0% Voids
#2A	215.25'	0.063 af	**Cultec R-902HD** x 42 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 3 Rows of 14 Chambers Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		0.104 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	214.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 212.50'

Discarded OutFlow Max=0.62 cfs @ 12.49 hrs HW=217.69' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.62 cfs)

Summary for Pond 4P: DCB-1

Inflow Area = 0.201 ac, 87.96% Impervious, Inflow Depth = 3.72" for 10yr 24hr event
Inflow = 0.75 cfs @ 12.09 hrs, Volume= 0.062 af
Outflow = 0.75 cfs @ 12.09 hrs, Volume= 0.062 af, Atten= 0%, Lag= 0.0 min
Primary = 0.75 cfs @ 12.09 hrs, Volume= 0.062 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.18' @ 12.09 hrs
Flood Elev= 220.68'

Device	Routing	Invert	Outlet Devices
#1	Primary	217.68'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.68' / 217.48' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.73 cfs @ 12.09 hrs HW=218.17' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.73 cfs @ 1.89 fps)

Summary for Pond 12P: DCB-2

Inflow Area = 0.224 ac, 95.31% Impervious, Inflow Depth = 4.02" for 10yr 24hr event
Inflow = 0.90 cfs @ 12.09 hrs, Volume= 0.075 af
Outflow = 0.90 cfs @ 12.09 hrs, Volume= 0.075 af, Atten= 0%, Lag= 0.0 min
Primary = 0.90 cfs @ 12.09 hrs, Volume= 0.075 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.85' @ 12.09 hrs
Flood Elev= 220.29'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.29'	**12.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.29' / 216.13' S= 0.0160 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.88 cfs @ 12.09 hrs HW=216.84' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.88 cfs @ 1.99 fps)

Summary for Pond 13P: CB-3

Inflow Area = 0.125 ac, 84.40% Impervious, Inflow Depth = 3.57" for 10yr 24hr event
Inflow = 0.45 cfs @ 12.09 hrs, Volume= 0.037 af
Outflow = 0.45 cfs @ 12.09 hrs, Volume= 0.037 af, Atten= 0%, Lag= 0.0 min
Primary = 0.45 cfs @ 12.09 hrs, Volume= 0.037 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.63' @ 12.09 hrs
Flood Elev= 220.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.25'	**12.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.25' / 216.13' S= 0.0120 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.44 cfs @ 12.09 hrs HW=216.63' (Free Discharge)
↑**1=Culvert** (Barrel Controls 0.44 cfs @ 2.37 fps)

Summary for Pond 14P: DCB-4

Inflow Area = 0.254 ac, 92.63% Impervious, Inflow Depth = 3.91" for 10yr 24hr event
Inflow = 1.00 cfs @ 12.09 hrs, Volume= 0.083 af
Outflow = 1.00 cfs @ 12.09 hrs, Volume= 0.083 af, Atten= 0%, Lag= 0.0 min
Primary = 1.00 cfs @ 12.09 hrs, Volume= 0.083 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 217.93' @ 12.09 hrs
Flood Elev= 220.34'

Device	Routing	Invert	Outlet Devices
#1	Primary	217.34'	**12.0" Round Culvert** L= 12.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.34' / 217.10' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.97 cfs @ 12.09 hrs HW=217.92' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.97 cfs @ 2.05 fps)

Summary for Pond 15P: CB-5

Inflow Area = 0.134 ac, 89.12% Impervious, Inflow Depth = 3.77" for 10yr 24hr event
Inflow = 0.51 cfs @ 12.09 hrs, Volume= 0.042 af
Outflow = 0.51 cfs @ 12.09 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.0 min
Primary = 0.51 cfs @ 12.09 hrs, Volume= 0.042 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.79' @ 12.09 hrs
Flood Elev= 219.39'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.39'	**12.0" Round Culvert** L= 28.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.39' / 216.11' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.49 cfs @ 12.09 hrs HW=216.79' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.49 cfs @ 1.70 fps)

Summary for Pond 16P: DMH-2

Inflow Area = 0.349 ac, 91.40% Impervious, Inflow Depth = 3.86" for 10yr 24hr event
Inflow = 1.35 cfs @ 12.09 hrs, Volume= 0.112 af
Outflow = 1.35 cfs @ 12.09 hrs, Volume= 0.112 af, Atten= 0%, Lag= 0.0 min
Primary = 1.35 cfs @ 12.09 hrs, Volume= 0.112 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.74' @ 12.09 hrs
Flood Elev= 220.24'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.03'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.03' / 215.67' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.32 cfs @ 12.09 hrs HW=216.73' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.32 cfs @ 2.25 fps)

Summary for Pond 17P: DMH-4

Inflow Area = 0.388 ac, 91.41% Impervious, Inflow Depth = 3.86" for 10yr 24hr event
Inflow = 1.51 cfs @ 12.09 hrs, Volume= 0.125 af
Outflow = 1.51 cfs @ 12.09 hrs, Volume= 0.125 af, Atten= 0%, Lag= 0.0 min
Primary = 1.51 cfs @ 12.09 hrs, Volume= 0.125 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.77' @ 12.09 hrs
Flood Elev= 220.13'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.01'	**12.0" Round Culvert** L= 34.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.01' / 215.67' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.47 cfs @ 12.09 hrs HW=216.76' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.47 cfs @ 2.33 fps)

Summary for Link 1L: EXIST. WETLANDS

Inflow Area = 4.411 ac, 7.31% Impervious, Inflow Depth = 0.38" for 10yr 24hr event
Inflow = 1.02 cfs @ 12.30 hrs, Volume= 0.140 af
Primary = 1.02 cfs @ 12.30 hrs, Volume= 0.140 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: POST A Runoff Area=192,152 sf 7.31% Impervious Runoff Depth=0.52"
Flow Length=358' Tc=22.8 min CN=WQ Runoff=1.22 cfs 0.190 af

Subcatchment 2S: ROOF Runoff Area=10,991 sf 100.00% Impervious Runoff Depth=5.01"
Tc=6.0 min CN=98 Runoff=1.27 cfs 0.105 af

Subcatchment CB1: DCB-1 Runoff Area=8,766 sf 87.96% Impervious Runoff Depth=4.44"
Tc=6.0 min CN=WQ Runoff=0.89 cfs 0.074 af

Subcatchment CB2: DCB-2 Runoff Area=9,742 sf 95.31% Impervious Runoff Depth=4.79"
Tc=6.0 min CN=WQ Runoff=1.07 cfs 0.089 af

Subcatchment CB3: CB-3 Runoff Area=5,444 sf 84.40% Impervious Runoff Depth=4.27"
Tc=6.0 min CN=WQ Runoff=0.53 cfs 0.044 af

Subcatchment CB4: DCB-4 Runoff Area=11,066 sf 92.63% Impervious Runoff Depth=4.66"
Tc=6.0 min CN=WQ Runoff=1.18 cfs 0.099 af

Subcatchment CB5: CB-5 Runoff Area=5,857 sf 89.12% Impervious Runoff Depth=4.50"
Tc=6.0 min CN=WQ Runoff=0.60 cfs 0.050 af

Pond 1P: INFIL. 1 Peak Elev=218.30' Storage=0.050 af Inflow=2.15 cfs 0.180 af
Outflow=0.46 cfs 0.180 af

Pond 2P: INFIL. 2 Peak Elev=218.47' Storage=0.080 af Inflow=3.38 cfs 0.283 af
Outflow=0.71 cfs 0.283 af

Pond 4P: DCB-1 Peak Elev=218.23' Inflow=0.89 cfs 0.074 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0100 '/' Outflow=0.89 cfs 0.074 af

Pond 12P: DCB-2 Peak Elev=216.91' Inflow=1.07 cfs 0.089 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0160 '/' Outflow=1.07 cfs 0.089 af

Pond 13P: CB-3 Peak Elev=216.67' Inflow=0.53 cfs 0.044 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0120 '/' Outflow=0.53 cfs 0.044 af

Pond 14P: DCB-4 Peak Elev=217.99' Inflow=1.18 cfs 0.099 af
12.0" Round Culvert n=0.013 L=12.0' S=0.0200 '/' Outflow=1.18 cfs 0.099 af

Pond 15P: CB-5 Peak Elev=216.83' Inflow=0.60 cfs 0.050 af
12.0" Round Culvert n=0.013 L=28.0' S=0.0100 '/' Outflow=0.60 cfs 0.050 af

Pond 16P: DMH-2 Peak Elev=216.82' Inflow=1.60 cfs 0.134 af
12.0" Round Culvert n=0.013 L=36.0' S=0.0100 '/' Outflow=1.60 cfs 0.134 af

Pond 17P: DMH-4 Peak Elev=216.87' Inflow=1.78 cfs 0.149 af
12.0" Round Culvert n=0.013 L=34.0' S=0.0100 '/' Outflow=1.78 cfs 0.149 af

Link 1L: EXIST. WETLANDS

Inflow=1.22 cfs 0.190 af
Primary=1.22 cfs 0.190 af

Total Runoff Area = 5.602 ac Runoff Volume = 0.653 af Average Runoff Depth = 1.40"
74.56% Pervious = 4.176 ac 25.44% Impervious = 1.425 ac

Summary for Subcatchment 1S: POST A

Runoff = 1.22 cfs @ 12.31 hrs, Volume= 0.190 af, Depth= 0.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr 24hr Rainfall=5.25"

Area (sf)	CN	Description
11,556	98	Paved parking, HSG A
3,214	76	Gravel roads, HSG A
73,451	39	>75% Grass cover, Good, HSG A
101,449	30	Woods, Good, HSG A
2,482	98	Roofs, HSG A
192,152		Weighted Average
178,114	35	92.69% Pervious Area
14,038	98	7.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
6.1	308	0.0280	0.84		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
22.8	358	Total			

Summary for Subcatchment 2S: ROOF

Runoff = 1.27 cfs @ 12.09 hrs, Volume= 0.105 af, Depth= 5.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr 24hr Rainfall=5.25"

Area (sf)	CN	Description
10,991	98	Roofs, HSG A
10,991	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB1: DCB-1

Runoff = 0.89 cfs @ 12.09 hrs, Volume= 0.074 af, Depth= 4.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr 24hr Rainfall=5.25"

Area (sf)	CN	Description
7,711	98	Paved parking, HSG A
1,055	39	>75% Grass cover, Good, HSG A
8,766		Weighted Average
1,055	39	12.04% Pervious Area
7,711	98	87.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB2: DCB-2

Runoff = 1.07 cfs @ 12.09 hrs, Volume= 0.089 af, Depth= 4.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr 24hr Rainfall=5.25"

Area (sf)	CN	Description
9,285	98	Paved parking, HSG A
457	39	>75% Grass cover, Good, HSG A
9,742		Weighted Average
457	39	4.69% Pervious Area
9,285	98	95.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB3: CB-3

Runoff = 0.53 cfs @ 12.09 hrs, Volume= 0.044 af, Depth= 4.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr 24hr Rainfall=5.25"

Area (sf)	CN	Description
4,595	98	Paved parking, HSG A
849	39	>75% Grass cover, Good, HSG A
5,444		Weighted Average
849	39	15.60% Pervious Area
4,595	98	84.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB4: DCB-4

Runoff = 1.18 cfs @ 12.09 hrs, Volume= 0.099 af, Depth= 4.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr 24hr Rainfall=5.25"

Area (sf)	CN	Description
10,250	98	Paved parking, HSG A
816	39	>75% Grass cover, Good, HSG A
11,066		Weighted Average
816	39	7.37% Pervious Area
10,250	98	92.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB5: CB-5

Runoff = 0.60 cfs @ 12.09 hrs, Volume= 0.050 af, Depth= 4.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr 24hr Rainfall=5.25"

Area (sf)	CN	Description
5,220	98	Paved parking, HSG A
637	39	>75% Grass cover, Good, HSG A
5,857		Weighted Average
637	39	10.88% Pervious Area
5,220	98	89.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Pond 1P: INFIL. 1

Inflow Area = 0.454 ac, 94.66% Impervious, Inflow Depth = 4.76" for 25yr 24hr event
Inflow = 2.15 cfs @ 12.09 hrs, Volume= 0.180 af
Outflow = 0.46 cfs @ 12.50 hrs, Volume= 0.180 af, Atten= 79%, Lag= 24.7 min
Discarded = 0.46 cfs @ 12.50 hrs, Volume= 0.180 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.30' @ 12.50 hrs Surf.Area= 0.019 ac Storage= 0.050 af
Flood Elev= 220.25' Surf.Area= 0.019 ac Storage= 0.068 af

Plug-Flow detention time= 35.0 min calculated for 0.180 af (100% of inflow)
Center-of-Mass det. time= 35.0 min (782.9 - 747.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	214.50'	0.028 af	**23.00'W x 36.03'L x 5.75'H Field A** 0.109 af Overall - 0.041 af Embedded = 0.069 af x 40.0% Voids
#2A	215.25'	0.041 af	**Cultec R-902HD** x 27 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 3 Rows of 9 Chambers Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		0.068 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	214.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 212.50'

Discarded OutFlow Max=0.46 cfs @ 12.50 hrs HW=218.30' (Free Discharge)
1=Exfiltration (Controls 0.46 cfs)

Summary for Pond 2P: INFIL. 2

Inflow Area = 0.737 ac, 91.41% Impervious, Inflow Depth = 4.60" for 25yr 24hr event
Inflow = 3.38 cfs @ 12.09 hrs, Volume= 0.283 af
Outflow = 0.71 cfs @ 12.50 hrs, Volume= 0.283 af, Atten= 79%, Lag= 24.9 min
Discarded = 0.71 cfs @ 12.50 hrs, Volume= 0.283 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.47' @ 12.50 hrs Surf.Area= 0.029 ac Storage= 0.080 af
Flood Elev= 220.25' Surf.Area= 0.029 ac Storage= 0.104 af

Plug-Flow detention time= 36.5 min calculated for 0.283 af (100% of inflow)
Center-of-Mass det. time= 36.5 min (784.8 - 748.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	214.50'	0.041 af	**23.00'W x 54.37'L x 5.75'H Field A** 0.165 af Overall - 0.063 af Embedded = 0.102 af x 40.0% Voids
#2A	215.25'	0.063 af	**Cultec R-902HD** x 42 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 3 Rows of 14 Chambers Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		0.104 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	214.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 212.50'

Discarded OutFlow Max=0.71 cfs @ 12.50 hrs HW=218.47' (Free Discharge)
1=Exfiltration (Controls 0.71 cfs)

Summary for Pond 4P: DCB-1

Inflow Area = 0.201 ac, 87.96% Impervious, Inflow Depth = 4.44" for 25yr 24hr event
Inflow = 0.89 cfs @ 12.09 hrs, Volume= 0.074 af
Outflow = 0.89 cfs @ 12.09 hrs, Volume= 0.074 af, Atten= 0%, Lag= 0.0 min
Primary = 0.89 cfs @ 12.09 hrs, Volume= 0.074 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.23' @ 12.09 hrs
Flood Elev= 220.68'

Device	Routing	Invert	Outlet Devices
#1	Primary	217.68'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.68' / 217.48' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.86 cfs @ 12.09 hrs HW=218.23' (Free Discharge)
↑**1=Culvert** (Barrel Controls 0.86 cfs @ 2.86 fps)

Summary for Pond 12P: DCB-2

Inflow Area = 0.224 ac, 95.31% Impervious, Inflow Depth = 4.79" for 25yr 24hr event
Inflow = 1.07 cfs @ 12.09 hrs, Volume= 0.089 af
Outflow = 1.07 cfs @ 12.09 hrs, Volume= 0.089 af, Atten= 0%, Lag= 0.0 min
Primary = 1.07 cfs @ 12.09 hrs, Volume= 0.089 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.91' @ 12.09 hrs
Flood Elev= 220.29'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.29'	**12.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.29' / 216.13' S= 0.0160 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.04 cfs @ 12.09 hrs HW=216.90' (Free Discharge)
↑**1=Culvert** (Barrel Controls 1.04 cfs @ 2.99 fps)

Summary for Pond 13P: CB-3

Inflow Area = 0.125 ac, 84.40% Impervious, Inflow Depth = 4.27" for 25yr 24hr event
Inflow = 0.53 cfs @ 12.09 hrs, Volume= 0.044 af
Outflow = 0.53 cfs @ 12.09 hrs, Volume= 0.044 af, Atten= 0%, Lag= 0.0 min
Primary = 0.53 cfs @ 12.09 hrs, Volume= 0.044 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.67' @ 12.09 hrs
Flood Elev= 220.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.25'	**12.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.25' / 216.13' S= 0.0120 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.51 cfs @ 12.09 hrs HW=216.67' (Free Discharge)
1=Culvert (Barrel Controls 0.51 cfs @ 2.45 fps)

Summary for Pond 14P: DCB-4

Inflow Area = 0.254 ac, 92.63% Impervious, Inflow Depth = 4.66" for 25yr 24hr event
Inflow = 1.18 cfs @ 12.09 hrs, Volume= 0.099 af
Outflow = 1.18 cfs @ 12.09 hrs, Volume= 0.099 af, Atten= 0%, Lag= 0.0 min
Primary = 1.18 cfs @ 12.09 hrs, Volume= 0.099 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 217.99' @ 12.09 hrs
Flood Elev= 220.34'

Device	Routing	Invert	Outlet Devices
#1	Primary	217.34'	**12.0" Round Culvert** L= 12.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.34' / 217.10' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.15 cfs @ 12.09 hrs HW=217.98' (Free Discharge)
1=Culvert (Inlet Controls 1.15 cfs @ 2.15 fps)

Summary for Pond 15P: CB-5

Inflow Area = 0.134 ac, 89.12% Impervious, Inflow Depth = 4.50" for 25yr 24hr event
Inflow = 0.60 cfs @ 12.09 hrs, Volume= 0.050 af
Outflow = 0.60 cfs @ 12.09 hrs, Volume= 0.050 af, Atten= 0%, Lag= 0.0 min
Primary = 0.60 cfs @ 12.09 hrs, Volume= 0.050 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.83' @ 12.09 hrs
Flood Elev= 219.39'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.39'	**12.0" Round Culvert** L= 28.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.39' / 216.11' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.58 cfs @ 12.09 hrs HW=216.83' (Free Discharge)
1=Culvert (Inlet Controls 0.58 cfs @ 1.78 fps)

Summary for Pond 16P: DMH-2

Inflow Area = 0.349 ac, 91.40% Impervious, Inflow Depth = 4.60" for 25yr 24hr event
Inflow = 1.60 cfs @ 12.09 hrs, Volume= 0.134 af
Outflow = 1.60 cfs @ 12.09 hrs, Volume= 0.134 af, Atten= 0%, Lag= 0.0 min
Primary = 1.60 cfs @ 12.09 hrs, Volume= 0.134 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.82' @ 12.09 hrs
Flood Elev= 220.24'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.03'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.03' / 215.67' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.56 cfs @ 12.09 hrs HW=216.81' (Free Discharge)
↑**1=Culvert** (Inlet Controls 1.56 cfs @ 2.37 fps)

Summary for Pond 17P: DMH-4

Inflow Area = 0.388 ac, 91.41% Impervious, Inflow Depth = 4.60" for 25yr 24hr event
Inflow = 1.78 cfs @ 12.09 hrs, Volume= 0.149 af
Outflow = 1.78 cfs @ 12.09 hrs, Volume= 0.149 af, Atten= 0%, Lag= 0.0 min
Primary = 1.78 cfs @ 12.09 hrs, Volume= 0.149 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.87' @ 12.09 hrs
Flood Elev= 220.13'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.01'	**12.0" Round Culvert** L= 34.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.01' / 215.67' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.73 cfs @ 12.09 hrs HW=216.85' (Free Discharge)
↑**1=Culvert** (Inlet Controls 1.73 cfs @ 2.46 fps)

Summary for Link 1L: EXIST. WETLANDS

Inflow Area = 4.411 ac, 7.31% Impervious, Inflow Depth = 0.52" for 25yr 24hr event
Inflow = 1.22 cfs @ 12.31 hrs, Volume= 0.190 af
Primary = 1.22 cfs @ 12.31 hrs, Volume= 0.190 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: POST A Runoff Area=192,152 sf 7.31% Impervious Runoff Depth=0.78"
Flow Length=358' Tc=22.8 min CN=WQ Runoff=1.67 cfs 0.286 af

Subcatchment 2S: ROOF Runoff Area=10,991 sf 100.00% Impervious Runoff Depth=6.11"
Tc=6.0 min CN=98 Runoff=1.53 cfs 0.129 af

Subcatchment CB1: DCB-1 Runoff Area=8,766 sf 87.96% Impervious Runoff Depth=5.44"
Tc=6.0 min CN=WQ Runoff=1.08 cfs 0.091 af

Subcatchment CB2: DCB-2 Runoff Area=9,742 sf 95.31% Impervious Runoff Depth=5.85"
Tc=6.0 min CN=WQ Runoff=1.30 cfs 0.109 af

Subcatchment CB3: CB-3 Runoff Area=5,444 sf 84.40% Impervious Runoff Depth=5.24"
Tc=6.0 min CN=WQ Runoff=0.64 cfs 0.055 af

Subcatchment CB4: DCB-4 Runoff Area=11,066 sf 92.63% Impervious Runoff Depth=5.70"
Tc=6.0 min CN=WQ Runoff=1.43 cfs 0.121 af

Subcatchment CB5: CB-5 Runoff Area=5,857 sf 89.12% Impervious Runoff Depth=5.51"
Tc=6.0 min CN=WQ Runoff=0.73 cfs 0.062 af

Pond 1P: INFIL. 1 Peak Elev=219.70' Storage=0.064 af Inflow=2.61 cfs 0.220 af
Outflow=0.57 cfs 0.220 af

Pond 2P: INFIL. 2 Peak Elev=220.04' Storage=0.101 af Inflow=4.10 cfs 0.346 af
Outflow=0.90 cfs 0.346 af

Pond 4P: DCB-1 Peak Elev=218.30' Inflow=1.08 cfs 0.091 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0100 '/' Outflow=1.08 cfs 0.091 af

Pond 12P: DCB-2 Peak Elev=216.99' Inflow=1.30 cfs 0.109 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0160 '/' Outflow=1.30 cfs 0.109 af

Pond 13P: CB-3 Peak Elev=216.72' Inflow=0.64 cfs 0.055 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0120 '/' Outflow=0.64 cfs 0.055 af

Pond 14P: DCB-4 Peak Elev=218.08' Inflow=1.43 cfs 0.121 af
12.0" Round Culvert n=0.013 L=12.0' S=0.0200 '/' Outflow=1.43 cfs 0.121 af

Pond 15P: CB-5 Peak Elev=216.88' Inflow=0.73 cfs 0.062 af
12.0" Round Culvert n=0.013 L=28.0' S=0.0100 '/' Outflow=0.73 cfs 0.062 af

Pond 16P: DMH-2 Peak Elev=216.95' Inflow=1.94 cfs 0.164 af
12.0" Round Culvert n=0.013 L=36.0' S=0.0100 '/' Outflow=1.94 cfs 0.164 af

Pond 17P: DMH-4 Peak Elev=217.03' Inflow=2.16 cfs 0.182 af
12.0" Round Culvert n=0.013 L=34.0' S=0.0100 '/' Outflow=2.16 cfs 0.182 af

Link 1L: EXIST. WETLANDS

Inflow=1.67 cfs 0.286 af
Primary=1.67 cfs 0.286 af

Total Runoff Area = 5.602 ac Runoff Volume = 0.852 af Average Runoff Depth = 1.82"
74.56% Pervious = 4.176 ac 25.44% Impervious = 1.425 ac

Summary for Subcatchment 1S: POST A

Runoff = 1.67 cfs @ 12.34 hrs, Volume= 0.286 af, Depth= 0.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr 24hr Rainfall=6.35"

Area (sf)	CN	Description
11,556	98	Paved parking, HSG A
3,214	76	Gravel roads, HSG A
73,451	39	>75% Grass cover, Good, HSG A
101,449	30	Woods, Good, HSG A
2,482	98	Roofs, HSG A
192,152		Weighted Average
178,114	35	92.69% Pervious Area
14,038	98	7.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
6.1	308	0.0280	0.84		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
22.8	358	Total			

Summary for Subcatchment 2S: ROOF

Runoff = 1.53 cfs @ 12.09 hrs, Volume= 0.129 af, Depth= 6.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr 24hr Rainfall=6.35"

Area (sf)	CN	Description
10,991	98	Roofs, HSG A
10,991	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB1: DCB-1

Runoff = 1.08 cfs @ 12.09 hrs, Volume= 0.091 af, Depth= 5.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr 24hr Rainfall=6.35"

Area (sf)	CN	Description
7,711	98	Paved parking, HSG A
1,055	39	>75% Grass cover, Good, HSG A
8,766		Weighted Average
1,055	39	12.04% Pervious Area
7,711	98	87.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB2: DCB-2

Runoff = 1.30 cfs @ 12.09 hrs, Volume= 0.109 af, Depth= 5.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr 24hr Rainfall=6.35"

Area (sf)	CN	Description
9,285	98	Paved parking, HSG A
457	39	>75% Grass cover, Good, HSG A
9,742		Weighted Average
457	39	4.69% Pervious Area
9,285	98	95.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB3: CB-3

Runoff = 0.64 cfs @ 12.09 hrs, Volume= 0.055 af, Depth= 5.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr 24hr Rainfall=6.35"

Area (sf)	CN	Description
4,595	98	Paved parking, HSG A
849	39	>75% Grass cover, Good, HSG A
5,444		Weighted Average
849	39	15.60% Pervious Area
4,595	98	84.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB4: DCB-4

Runoff = 1.43 cfs @ 12.09 hrs, Volume= 0.121 af, Depth= 5.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr 24hr Rainfall=6.35"

Area (sf)	CN	Description
10,250	98	Paved parking, HSG A
816	39	>75% Grass cover, Good, HSG A
11,066		Weighted Average
816	39	7.37% Pervious Area
10,250	98	92.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment CB5: CB-5

Runoff = 0.73 cfs @ 12.09 hrs, Volume= 0.062 af, Depth= 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100yr 24hr Rainfall=6.35"

Area (sf)	CN	Description
5,220	98	Paved parking, HSG A
637	39	>75% Grass cover, Good, HSG A
5,857		Weighted Average
637	39	10.88% Pervious Area
5,220	98	89.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Pond 1P: INFIL. 1

Inflow Area = 0.454 ac, 94.66% Impervious, Inflow Depth = 5.81" for 100yr 24hr event
Inflow = 2.61 cfs @ 12.09 hrs, Volume= 0.220 af
Outflow = 0.57 cfs @ 12.49 hrs, Volume= 0.220 af, Atten= 78%, Lag= 24.5 min
Discarded = 0.57 cfs @ 12.49 hrs, Volume= 0.220 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 219.70' @ 12.49 hrs Surf.Area= 0.019 ac Storage= 0.064 af
Flood Elev= 220.25' Surf.Area= 0.019 ac Storage= 0.068 af

Plug-Flow detention time= 40.2 min calculated for 0.220 af (100% of inflow)
Center-of-Mass det. time= 40.1 min (785.5 - 745.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	214.50'	0.028 af	**23.00'W x 36.03'L x 5.75'H Field A** 0.109 af Overall - 0.041 af Embedded = 0.069 af x 40.0% Voids
#2A	215.25'	0.041 af	**Cultec R-902HD** x 27 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 3 Rows of 9 Chambers Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		0.068 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	214.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 212.50'

Discarded OutFlow Max=0.57 cfs @ 12.49 hrs HW=219.69' (Free Discharge)
↑**1=Exfiltration** (Controls 0.57 cfs)

Summary for Pond 2P: INFIL. 2

Inflow Area = 0.737 ac, 91.41% Impervious, Inflow Depth = 5.63" for 100yr 24hr event
Inflow = 4.10 cfs @ 12.09 hrs, Volume= 0.346 af
Outflow = 0.90 cfs @ 12.49 hrs, Volume= 0.346 af, Atten= 78%, Lag= 24.4 min
Discarded = 0.90 cfs @ 12.49 hrs, Volume= 0.346 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 220.04' @ 12.49 hrs Surf.Area= 0.029 ac Storage= 0.101 af
Flood Elev= 220.25' Surf.Area= 0.029 ac Storage= 0.104 af

Plug-Flow detention time= 41.5 min calculated for 0.346 af (100% of inflow)
Center-of-Mass det. time= 41.5 min (787.5 - 746.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	214.50'	0.041 af	**23.00'W x 54.37'L x 5.75'H Field A** 0.165 af Overall - 0.063 af Embedded = 0.102 af x 40.0% Voids
#2A	215.25'	0.063 af	**Cultec R-902HD** x 42 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 3 Rows of 14 Chambers Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		0.104 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	214.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 212.50'

Discarded OutFlow Max=0.90 cfs @ 12.49 hrs HW=220.03' (Free Discharge)
↑**1=Exfiltration** (Controls 0.90 cfs)

Summary for Pond 4P: DCB-1

Inflow Area = 0.201 ac, 87.96% Impervious, Inflow Depth = 5.44" for 100yr 24hr event
Inflow = 1.08 cfs @ 12.09 hrs, Volume= 0.091 af
Outflow = 1.08 cfs @ 12.09 hrs, Volume= 0.091 af, Atten= 0%, Lag= 0.0 min
Primary = 1.08 cfs @ 12.09 hrs, Volume= 0.091 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.30' @ 12.09 hrs
Flood Elev= 220.68'

Device	Routing	Invert	Outlet Devices
#1	Primary	217.68'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.68' / 217.48' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.05 cfs @ 12.09 hrs HW=218.29' (Free Discharge)
1=Culvert (Barrel Controls 1.05 cfs @ 2.97 fps)

Summary for Pond 12P: DCB-2

Inflow Area = 0.224 ac, 95.31% Impervious, Inflow Depth = 5.85" for 100yr 24hr event
Inflow = 1.30 cfs @ 12.09 hrs, Volume= 0.109 af
Outflow = 1.30 cfs @ 12.09 hrs, Volume= 0.109 af, Atten= 0%, Lag= 0.0 min
Primary = 1.30 cfs @ 12.09 hrs, Volume= 0.109 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.99' @ 12.09 hrs
Flood Elev= 220.29'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.29'	**12.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.29' / 216.13' S= 0.0160 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.26 cfs @ 12.09 hrs HW=216.97' (Free Discharge)
1=Culvert (Barrel Controls 1.26 cfs @ 3.11 fps)

Summary for Pond 13P: CB-3

Inflow Area = 0.125 ac, 84.40% Impervious, Inflow Depth = 5.24" for 100yr 24hr event
Inflow = 0.64 cfs @ 12.09 hrs, Volume= 0.055 af
Outflow = 0.64 cfs @ 12.09 hrs, Volume= 0.055 af, Atten= 0%, Lag= 0.0 min
Primary = 0.64 cfs @ 12.09 hrs, Volume= 0.055 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.72' @ 12.09 hrs
Flood Elev= 220.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.25'	**12.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.25' / 216.13' S= 0.0120 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.63 cfs @ 12.09 hrs HW=216.72' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 0.63 cfs @ 2.55 fps)

Summary for Pond 14P: DCB-4

Inflow Area = 0.254 ac, 92.63% Impervious, Inflow Depth = 5.70" for 100yr 24hr event
Inflow = 1.43 cfs @ 12.09 hrs, Volume= 0.121 af
Outflow = 1.43 cfs @ 12.09 hrs, Volume= 0.121 af, Atten= 0%, Lag= 0.0 min
Primary = 1.43 cfs @ 12.09 hrs, Volume= 0.121 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.08' @ 12.09 hrs
Flood Elev= 220.34'

Device	Routing	Invert	Outlet Devices
#1	Primary	217.34'	**12.0" Round Culvert** L= 12.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.34' / 217.10' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.39 cfs @ 12.09 hrs HW=218.06' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.39 cfs @ 2.29 fps)

Summary for Pond 15P: CB-5

Inflow Area = 0.134 ac, 89.12% Impervious, Inflow Depth = 5.51" for 100yr 24hr event
Inflow = 0.73 cfs @ 12.09 hrs, Volume= 0.062 af
Outflow = 0.73 cfs @ 12.09 hrs, Volume= 0.062 af, Atten= 0%, Lag= 0.0 min
Primary = 0.73 cfs @ 12.09 hrs, Volume= 0.062 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.88' @ 12.09 hrs
Flood Elev= 219.39'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.39'	**12.0" Round Culvert** L= 28.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.39' / 216.11' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.71 cfs @ 12.09 hrs HW=216.88' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.71 cfs @ 1.87 fps)

Summary for Pond 16P: DMH-2

Inflow Area = 0.349 ac, 91.40% Impervious, Inflow Depth = 5.63" for 100yr 24hr event
Inflow = 1.94 cfs @ 12.09 hrs, Volume= 0.164 af
Outflow = 1.94 cfs @ 12.09 hrs, Volume= 0.164 af, Atten= 0%, Lag= 0.0 min
Primary = 1.94 cfs @ 12.09 hrs, Volume= 0.164 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 216.95' @ 12.09 hrs
Flood Elev= 220.24'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.03'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.03' / 215.67' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.89 cfs @ 12.09 hrs HW=216.93' (Free Discharge)
↑**1=Culvert** (Inlet Controls 1.89 cfs @ 2.55 fps)

Summary for Pond 17P: DMH-4

Inflow Area = 0.388 ac, 91.41% Impervious, Inflow Depth = 5.63" for 100yr 24hr event
Inflow = 2.16 cfs @ 12.09 hrs, Volume= 0.182 af
Outflow = 2.16 cfs @ 12.09 hrs, Volume= 0.182 af, Atten= 0%, Lag= 0.0 min
Primary = 2.16 cfs @ 12.09 hrs, Volume= 0.182 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 217.03' @ 12.09 hrs
Flood Elev= 220.13'

Device	Routing	Invert	Outlet Devices
#1	Primary	216.01'	**12.0" Round Culvert** L= 34.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 216.01' / 215.67' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.10 cfs @ 12.09 hrs HW=217.00' (Free Discharge)
↑**1=Culvert** (Inlet Controls 2.10 cfs @ 2.68 fps)

Summary for Link 1L: EXIST. WETLANDS

Inflow Area = 4.411 ac, 7.31% Impervious, Inflow Depth = 0.78" for 100yr 24hr event
Inflow = 1.67 cfs @ 12.34 hrs, Volume= 0.286 af
Primary = 1.67 cfs @ 12.34 hrs, Volume= 0.286 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

APPENDIX F

Recharge Volume / Water Quality Volume / TSS Removal/ Mounding Calculations

Groton Senior Center
Groton, MA

January 29, 2018
5364

Groton Senior Center

Stormwater Recharge Calculations

CALCULATIONS

Recharge Volume, Rv:

$R_v = A_C x F$ (Static Method)

Hydrologic Soil Group	Impervious Area (Ac) [1]	Target Depth (F)	Recharge Volume (Rv) Ac-feet
A	1.103	0.6	0.055
Total	1.103		0.055

Total Recharge Volume Required =	0.055	Ac-ft
Total Recharge Volume Required (Rv) =	2,402	**C.ft**

Required Sediment Forebay vol, Fv:

$F_v = A_C(cu.ft) x 0.1 inch$ of impervious area

[1] Imp. area captured by ponds, Ap =	1.103	Ac
Required Sediment Forebay vol, Fv=	400	**C.ft**
[2]Sediment Volume Provided =	1,500	**C.ft**

Capture Area Adjustment, Rvadj:

$$R_v adj = \frac{A_t}{A_p} x R_v$$

[1] Imp. area captured by ponds, Ap =	1.103	Ac
[1] Total impervious area on site, AT =	1.103	Ac
Recharge volume required, Rv =	2,402	C.ft
Capture Rate=	100%	OK
Capture Area Adjustment Factor=	1.00	
Adjusted Recharge Volume Required Rvadj =	2,402	**C.ft**
[3] Total Recharge Volume Provided =	7,482	**C.ft**

REFERENCES

Table 2.3.2: Recharge Target Depth by Hydrologic Soil Group

NRCS Hydrologic Soil Group	Approx. Soil Texture	Target Depth Factor (F)
A	sand	0.6 inch
B	loam	0.35 inch
C	silty loam	0.25 inch
D	clay	0.1 inch

NOTES:

Input Values **Calculation Values**

[1] = Refer to Post Development HydroCAD modeling report (excludes impervious area from Post A)
[2] = Sediment forebay volume prodived is the volume of one row from each of the infiltration areas
[3] = Total Recharge Volume Provided is sum of chamber and stone storage from Infiltration Areas 1 and 2

Groton Senior Center
Groton, MA

January 29, 2018
5364

Groton Senior Center

Water Quality Calculations

CALCULATIONS

Water Quality Calculation:

$$V_{WQ} = D_{WQ}(ft) x\ A_T(ft^2)$$

Water Quality Depth =	1	in
Water Quality Depth , DwQ =	0.08	**ft.**
Total impervious area on site, AT =	1.103	Ac.
Impervious Area (captured by pond), Ac=	48,047	**ft²**
Required Water Quality Volume, VwQ =	4,004	**C.ft.**
[3] **Total Storage Provided From BMPs=**	7,482	**C.ft**

REFERENCES

1 inch depth
Zone II discharges
IWPA discharges
Critical Area
Runoff from LUHPPL
Infiltration rate >2.4 inches/hour
1/2 inch depth
Discharge to other ares
8 inch
9 inch
10 inch
11 inch

[1] = Refer to Post Development HydroCAD modeling report (excludes impervious area from Post A)
[3] = Total Storage Provided From BMPs is sum of chamber and stone storage from Infiltration Areas 1 and 2

Groton Senior Center

Drawdown Calculations

CALCULATIONS

Proposed Infiltration Area Calculations:

$$Drawdown = \frac{R_V}{(Rawls\ Rate)(Bottom\ Area)}$$

Drawdown Calculations:

Soil Texture: 1 Sand

[4] **Bottom Surface Area (A):**	2,079	SF
Rawls Rate:	8.27	in/hr
Total Adjusted Recharge Volume Required =	2,402	C.ft
Drawdown:	1.68	hr
	Drawdown is less than 72 Hours as Required	

NOTES:

Input Values Calculation Values

[4] = Total combined bottom surface area from Infiltration Areas 1 and 2

REFERENCES

Table 2.3.3: 1982 Rawls Rates

Texture Class	NRCS Hydrologic Soil Group	Infiltration Rate
1 Sand	A	8.27 in/hr
2 Loamy Sand	A	2.41 in/hr
3 Sandy Loam	B	1.02 in/hr
4 Loam	B	0.52 in/hr
5 Silt Loam	C	0.27 in/hr
6 Sandy Clay Loam	C	0.17 in/hr
7 Clay Loam	D	0.09 in/hr
8 Silty Clay Loam	D	0.06 in/hr
9 Sandy Clay	D	0.05 in/hr
10 Silty Clay	D	0.04 in/hr
11 Clay	D	0.02 in/hr

INSTRUCTIONS:

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: Total TSS Removal

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Subsurface Infiltration Structure	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Groton Senior Center**

Prepared By: **JPL**

Date: **29-Jan-18**

*Equals remaining load from previous BMP (E) which enters the BMP

INSTRUCTIONS:

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: Pre-Treatment

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Sediment Forebay	**0.25**	**0.75**	**0.19**	**0.56**
	0.00	**0.56**	**0.00**	**0.56**
	0.00	**0.56**	**0.00**	**0.56**
	0.00	**0.56**	**0.00**	**0.56**

Total TSS Removal = **44%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Groton Senior Center**
Prepared By: **JPL**
Date: **29-Jan-18**

*Equals remaining load from previous BMP (E) which enters the BMP

5364-GROTON SENIOR CENTER : INFIL. AREA 1

Groundwater Mound Beneath Rectangular Recharge Area

by Glenn M. Duffield, President, HydroSOLVE, Inc.

Hantush (1967) presented the following equations for predicting the maximum height of the water table beneath a rectangular recharge area:

$$h_m^2 - h_i^2 = Z_m(t) = (2w/K)\nu tS^*(0.5A/(4\nu t)^{1/2}, 0.5B/(4\nu t)^{1/2}) \quad . . . . . (1)$$

$$\nu = K\bar{b}/\varepsilon \quad . . . . . (2)$$

$$\bar{b} = 0.5[h_i(0) + h(t)] \quad . . . . . (3)$$

where h_m is maximum height of mound above aquifer base (i.e., maximum saturated thickness of aquifer beneath recharge area); h_i is initial height of water table above aquifer base (i.e., initial saturated thickness of aquifer); K and ε are hydraulic conductivity and storativity (specific yield) of aquifer, respectively; w is constant rate of percolation from rectangular recharge area of length A and width B; $\bar{b}$ is a constant of linearization; and the function S* is an integral expression (see Hantush 1967). The aquifer is unconfined and assumed to have infinite extent.

If infiltration ends at time $t=t_0$, Hantush (1967) applied the principle of superposition to compute the decay of the mound as follows:

$$h_m^2 - h_i^2 = Z_m(t) - Z_m(t-t_0) \quad . . . . . (4)$$

Equation (1) is nonlinear owing to the definition of $\bar{b}$ in Equation (3); however, the solution is readily obtained by successive approximation.

Results of Groundwater Mounding Calculation

Solution by Successive Approximation

Iteration	$\bar{b}$	h_m*	% Change
1	10	10.2755414376143	2.75541437614344
2	10.137770718807	10.2755679506726	2.5802103382766E-04
3	10.137783975336	10.2755679531892	2.44908981983372E-08

K [L/T]	ε	h_i [L]	A [L]	B [L]	w [L/T]	t [T]	h_m [L]
6.89	0.25	10	36.03	23.00	0.6892	72	10.2755679531892

maximum water-table rise (h_m - h_i) at time t = 72 is 0.275567953189171

decay of mound computed after time t = 25

Return to Groundwater Mounding Calculator

Click here for a benchmark for this calculator.

Hantush mounding calculations with contouring now available in AQTESOLV.

L = LENGTH = FT
T = TIME = HOURS

* USE RAWLS RATE OF 8.27 IN/HR (0.6892 FT/HR) FOR W.

* K = W x 10

A 0.27 FT RISE IN GW DOES NOT REACH CHAMBERS

TIME THAT POND STOPS INFILTRATION (SEE HYDRO CAD)

5364 - GROTON SENIOR CENTER: INFIL. AREA 2

Groundwater Mound Beneath Rectangular Recharge Area

by Glenn M. Duffield, President, HydroSOLVE, Inc.

Hantush (1967) presented the following equations for predicting the maximum height of the water table beneath a rectangular recharge area:

$$h_m^2 - h_i^2 = Z_m(t) = (2w/K)\nu t S^*(0.5A/(4\nu t)^{1/2}, 0.5B/(4\nu t)^{1/2}) \quad \ldots\ldots (1)$$

$$\nu = K\bar{b}/\varepsilon \quad \ldots\ldots (2)$$

$$\bar{b} = 0.5[h_i(0) + h(t)] \quad \ldots\ldots (3)$$

where h_m is maximum height of mound above aquifer base (i.e., maximum saturated thickness of aquifer beneath recharge area); h_i is initial height of water table above aquifer base (i.e., initial saturated thickness of aquifer); K and ε are hydraulic conductivity and storativity (specific yield) of aquifer, respectively; w is constant rate of percolation from rectangular recharge area of length A and width B; $\bar{b}$ is a constant of linearization; and the function S* is an integral expression (see Hantush 1967). The aquifer is unconfined and assumed to have infinite extent.

If infiltration ends at time $t=t_0$, Hantush (1967) applied the principle of superposition to compute the decay of the mound as follows:

$$h_m^2 - h_i^2 = Z_m(t) - Z_m(t-t_0) \quad \ldots\ldots (4)$$

Equation (1) is nonlinear owing to the definition of $\bar{b}$ in Equation (3); however, the solution is readily obtained by successive approximation.

Results of Groundwater Mounding Calculation

Solution by Successive Approximation

Iteration	$\bar{b}$	h_m*	% Change
1	10	10.4102549821249	4.10254982124867
2	10.205127491062	10.4103656049009	1.06263272350304E-03
3	10.205182802450	10.4103656341339	2.80806222718866E-07

K [L/T]	ε	h_i [L]	A [L]	B [L]	w [L/T]	t [T]	h_m [L]
6.892	0.25	10	54.37	23.00	0.6892	72	10.4103656341339

maximum water-table rise ($h_m - h_i$) at time t = 72 is 0.410365634133861

decay of mound computed after time t = 25

Return to Groundwater Mounding Calculator

Click here for a benchmark for this calculator.

Hantush mounding calculations with contouring now available in AQTESOLV.

Aquifer Test Forum
» Forum
» Methods
- Pumping Tests
+ Derivative Analysis
+ Leaky Aquifers
+ Skin Effect
+ Recovery Tests
+ Step-Drawdown Tests
- Slug Tests
- Tidal Effects
» Calculators
- Radius of Influence
- Specific Capacity to T (Approx.)
- Specific Capacity to T (Exact)
- Circular Mound
- Rectangular Mound
» Contact

L = LENGTH = FT
T = TIME = HOURS
★ USE RAWLS RATE OF 8.27 IN/HR (0.6892 FT/HR) FOR W.
★ K = W × 10

A 0.41 FT RISE IN GW DOES NOT REACH CHAMBERS

TIME THAT POND STOPS INFILTRATION (SEE HYDROCAD)

Soil Survey

- Soil Survey - Home
- Soil Surveys by State
- Partnerships
- Publications
- Soil Classification
- Soil Geography
- Tools
- Soil Survey Regional Offices
  - Portland, OR (SSR 1)
  - Davis, CA (SSR 2)
  - Raleigh, NC (SSR 3)
  - Bozeman, MT (SSR 4)
  - Salina, KS (SSR 5)
  - Morgantown, WV (SSR 6)
  - Auburn, AL (SSR 7)
  - Phoenix, AZ (SSR 8)
  - Temple, TX (SSR 9)
  - St. Paul, MN (SSR 10)
    - Contacts
    - Ecological Site Information
    - Soil Information
  - Indianapolis, IN (SSR 11)
  - Amherst, MA (SSR 12)
- Soil Climate Research Stations

Saturated Hydraulic Conductivity

Saturated Hydraulic Conductivity in Relation to Soil Texture

Saturated hydraulic conductivity rates shown are in relation to texture and are only a general guide.

Differences in bulk density may alter the rates shown below.

Soil Textural Classes & Related Saturated Hydraulic Conductivity Classes

Texture	Textural Class	General	Ksat Class	Ksat Rate (µm/sec.)
Coarse sand	Coarse	Sandy	V. rapid	> 141.14
Sands	Coarse	Sandy	Rapid	42.34-141.14
Loamy sands				
Sandy loam	Mod. coarse	Loamy	Mod. Rapid	14.11-42.34
Fi.san.loam				
v. fi. sa. loam	Medium	Loamy	Moderate	4.23-14.11
loam				
silt loam				
silt				
clay loam	Mod. fine	Loamy	Mod. slow	1.41-4.23
sa. cl. loam				
si. cl. loam				
sandy clay	Fine and very fine	Clayey	Slow	0.42-1.41
silty clay				
clay				
Cd horizon Natric horizon, fragipan, ortstein			V. slow or impermeable	0.00-0.42

ft/DAY
>40
12-40

Lecture 8

More Porosity, Specific Yield, Specific Retention

Fetter 4.2 & 4.3

Few naturally occurring sediments contain equidimensional spheres. If sediments are well sorted and well rounded, their porosity will range between **25 - 50%**. If they are mixed, the porosity will be lowered, because the smaller particles fill the voids between the larger ones. The wider the range in grain sizes, the lower the resulting porosity. So, for our Wooster example we had little variation in grain sizes, resulting in a high n_e.

S & G mixed	20-35%
Glacial fill	10-20%
Silt	35-50%
Clay	33-60%

Geological processes of running water, wind & glacial action create a wider range of grain sizes, shapes and orientations.

i.e., the Wooster sample represents outwash

- sorted glacial meltwater deposits.

Sedimentary Rocks - are formed from unconsolidated sediments through a process known as **diagenesis**. Diagenesis occurs when a sediment that is a product of weathering or chemically precipitated material is buried. During burial, the weight of the overlying materials causes compaction and movement of fluids which cement the grains and reduce pore volume. Therefore, diagenetic processes tend to reduce the porosity of the original sediments.

Ground water that is found between the grains is occupying the **Primary Porosity** of the rock. Often rocks may become fractured. Fractures may represent very small joints or large faults. Ground water stored in fractures is known as **Secondary Porosity**.

Ground water flowing through fractures may enlarge them by solution of material, particularly in limestone, dolomites & chemical sedimentary rocks. These rocks are composed of calcite $CaCO_3$ and dolomite $CaMgCO_3$, along with gypsum $CaSO_4$, precipitated from solution and may easily re-enter the solution.

Some limestones, have dissolution cavities large enough to allow someone tall enough to walk through them, for example Carlsbad Caverns or Mammoth Caves.

Plutonic (intrusive igneous) Rocks and ***Metamorphic Rocks*** (those formed by applying heat and pressure to pre-existing rocks) typically have low porosity. These rocks are not made by sedimentary processes, but are formed by sets of interlocking grains having virtually no pores, or very little primary porosity. Often, if these

rocks are exposed at the earth's surface, weathering an fracturing create secondary porosity as large as 30 - 60 %.

Volcanic (extrusive) Rocks - igneous rocks formed by extrusive processes are similar in chemical composition to plutonic rocks. Both rocks cool from molten rock, but volcanic rocks cool at the surface of the earth resulting in radically different porosities from plutonic rocks.

Rapid cooling of volcanic rocks produces shrinkage cracks. If degassing occurs during cooling, vesicles may form. Although these rocks may have many pores, most of them are unconnected. Lava tubes may be produced as well.

i.e., Place a piece of pumice in water. It will float due to the trapped air.

SUMMARY OF RANGE OF POROSITY VALUES

Fetter 4.3

ROCKS:

Fractured Basalt	5 - 50%
Karst Limestone	5 - 50%
Sandstone	5 - 30%
Limestone, Dolomite	0 - 20%
Shale	0 - 10%

Fractured crystalline rocks	0 - 10%
Dense crystalline rocks	0 - 5 %
Pumice	up to 87%

Although the porosity of a rock controls the quantity of water that may be stored, the effective porosity is the porosity available for fluid flow.

Effective Porosity porosity availability for fluid flow.

As water drains through pores, not all of the water will move. **Specific yield (S_y)** is the ratio of the volume of water that drains from a saturated rock (due to gravity) to the total volume of the rock.

Water molecules cling to pore surfaces due to surface tension of the water. Gravity exerts a force on the water film pulling some of it away from a grain and moves downward. The remaining water film on the grain will be thinner, with a greater surface tension, so that the force of gravity on the water particle will be equaled by the surface tension force, stopping gravity, drainage.

The **Specific Retention (S_r)** of a rock or soil is the ratio of the volume of water a rock can retain against gravity to the total volume of the rock.

Therefore, the total porosity is equal to the volume or water that a rock will yield by gravity drainage (S_y) and the volume held by surface tension (S_r) or:

$$n=S_y + S_r$$

Specific retention is greatest with the smallest grain sizes. For instance, a clay may have a porosity of 50% and a S_r (specific retention) of 48%. That means that if you have 1ℓ of clay, $.5\ell$ will be water and only $.02\ell$ of that water will drain by gravity.

S_y approximates Effective porosity

Effective Porosity

Sed size	Specific Yield % (avg)	Range
Clay	2%	0 - 5%
Silt	18%	3 - 19%
Med. Sand	26%	15 - 32%
Fine Sand	25%	21 - 35%
Course Gravel	22%	12 - 26 %

Maximum S_y occurs in sediments in the med. to coarse sand size range.

S_y may be determined in the lab. A sample of sediment of known volume is fully saturated. This is usually done in a soil column which is slowly flooded from the bottom, allowing the air to escape upward. The water is then allowed to gravity drain from the column. The ratio of the volume of water drained to the volume of the soil column is the specific yield.

Specific yield in the field is often estimated by a pumping test. We will return to specific yield when we discuss aquifer analysis methods.

ENV 302 - Lectures

MassDEP
Well Completion Report

1/15/2018 10:37:56 AM

WELL LOCATION

GPS North: GPS West: Assessors Map:
Address: 151R Hill Road Assessors Lot #:
Subdivision Name: Permit number:
City/Town: Groton Date Issued:
Board of Heath permit obtained: Y

Work Performed	Proposed Use	Drilling Method Overburden	Drilling Method Bedrock
	Domestic		

ADDITIONAL WELL INFORMATION

Developed : No
Disinfected : No
Total Well Depth : 305
Fracture Enhancement : No
Well Seal Type :
Depth to Bedrock : 45

PERMANENT PUMP (IF AVAILABLE)

Pump description :
Type :
Nominal Pump Capacity :
Intake Depth :
Horsepower :
Comments : 305' - 7 gpm

CASING

From (ft)	To (ft)	Type	Thickness	Diameter
	55	Steel		6

SCREEN

From (ft)	To (ft)	Type	Slot Size	Diameter

WELL SEAL / FILTER PACK / ABANDONMENT MATERIAL

From (ft)	To (ft)	Material Description	Purpose

STATIC WATER LEVEL (ALL WELLS)

Date Measured	Depth Below Ground Surface (ft)
10/24/1990	12

WELL TEST DATA (ALL SECTIONS MANDATORY FOR PRODUCTION WELLS)

Date	Method	Yield (GPM)	Time Pumped (hrs & min)	Pumping Level (Ft. BGS)	Time To Recover (Hrs & Min)	Recovery (Ft. BGS)
	Air Lift	7	1:00:00	305	3:00:00	305

OVER BURDEN

From (ft)	To (ft)	Lithology	Color	Comment	Water Zone	Loss/Add of fluid	Drill Stem Drop	Drill Rate

BEDROCK

From (ft)	To (ft)	Lithology	Comment	Water Zone	Drill Stem Drop	Extra Large	Drill Rate	Rust Stain	Loss/Add of fluid	# of Fract per ft

APPENDIX G

Operation and Maintenance Plan

STORMWATER OPERATION & MAINTENANCE MANUAL

163 West Main Street
Groton Senior Center

GROTON, MASSACHUSETTS

Prepared For: TOWN OF GROTON
173 MAIN STREET
GROTON, MA

Prepared By: DUCHARME & DILLIS CIVIL DESIGN GROUP, INC
1092 MAIN STREET
BOLTON, MA 01740

February 9, 2018
5364

TABLE OF CONTENTS:

1.0 Project Narrative

1.1 Proposed Stormwater Management System

Runoff from the proposed development will be conveyed and treated through a combination of Best Management Practices (BMP's). The following is a brief discussion of each conveyance and treatment BMP proposed.

Deep Sump Hooded Catch Basins

Deep sump hooded catch basins are proposed to convey the runoff from the proposed roadway to the subsurface infiltration system. These catch basins will discharge to manholes and conventional storm drains.

Subsurface Infiltration System

Subsurface infiltration systems are included on both the north and east sides of the parking lot. Cultec pre-fabricated chambers, model R-902HD, will be installed to collect the run off from the roofs and pavement after pretreatment in the deep sump hooded catch basins. The infiltration system will provide recharge for the groundwater as well.

1.2 Operation & Maintenance Tasks

The following activities should be performed routinely to allow for proper functioning of the stormwater system. The following are guidelines referring to each major component of the stormwater management system.

1.2.1 *Street Sweeping*

Street sweeping should be preformed at least semi annually. For most effective results, sweeping should be preformed by a vacuum style truck in the early spring before spring rain events can wash silt and sediment into the stormwater system. Silt and sediment should be disposed of in accordance with local, state and federal guidelines for hazardous waste.

1.2.2 *Drain Manholes*

Manholes shall be inspected semi-annually for signs of wear, settling, cracking or other fatigue. Manhole casting should be inspected for signs of root intrusion, or significant water infiltration. Weirs shall be inspected for signs of cracking or other fatigue. Manhole sumps should be checked for silt /sediment buildup and cleaned as necessary. Cleaning should be performed by a vacuum truck. Manholes should be resealed as required and outlets should be inspected incidentally with all structure inspections.

1.2.3 *Storm Drain Lines*

Storm drainage inlets and outlets should be inspected incidentally with all structure inspections. Evidence of debris intrusion or excessive siltation or sedimentation could result in the need to clean a storm drain line. Flushing or jetting should be performed as required. All flushing and jetting should be performed in the direction away from any outlet devices. A vacuum truck should be used at the opposite end of the flushing or jetting to remove any silt or sediment that is cleaned from the storm drain.

1.2.4 *Deep Sump Catch Basins*

Deep sump catch basins shall be inspected at least semi-annually for signs of wear, settling, cracking or other fatigue. Catch basin castings should be inspected for signs of root intrusion, or significant water infiltration. Catch basin sump should be check for silt/sediment buildup and cleaned as necessary. Cleaning should be performed by a vacuum truck. Catch basins should be resealed as required and outlets should be inspected incidentally with all structure inspections.

1.2.5 Subsurface Infiltration System

The subsurface infiltration systems should be monitored and maintained regularly to ensure no obstructions in the systems are present. Any depressions noticed in the areas could indicate that the system has collapsed and should be inspected immediately. The systems are equipped with inspection ports to monitor the buildup of sedimentation. If the depth of sedimentation is in excess of the manufacturer's guidelines, the systems will need to be cleaned out with high pressure water. The high-pressure water should be used on one end and a vacuum truck will be used on the opposite end to remove any silt or sediment that is cleaned from the chamber. Other maintenance will include checking the inlets and outlet for debris, survey the surrounding area for depressions and confirm no unauthorized modifications have been performed to the system. See Appendix A for the Cultec Operation and Maintenance Guidelines.

O&M Schedule

	O&M Task	Monthly	Quarterly	Spring	Fall	2-years	As-required
1.	**Street Sweeping**			**x**	**x**		
2.	**Drain Manholes**						
	Inspect Rims			**x**	**x**		
	Inspect inside/inlet and outlet pipes					**x**	
	Remove sediment					**x**	**x**
3.	**Storm drain Lines**						
	Inspection			**x**			**x**
	Clean						**x**
4.	**Catch Basins**						
	Inspect Rims			**x**	**x**		
	Inspect inside/inlet and outlet pipes					**x**	
	Remove sediment					**x**	**x**
5.	**Underground Infiltration Areas**	**(See appendix A)**					

APPENDIX A

Cultec Operation & Maintenance

Contactor® & Recharger®
Stormwater Chambers The Chamber With The Stripe®

Operation and Maintenance Guidelines

CULTEC™

Operation & Maintenance

This manual contains guidelines recommended by CULTEC, Inc. and may be used in conjunction with, but not to supersede, local regulations or regulatory authorities. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Introduction

The CULTEC Subsurface Stormwater Management System is a high-density polyethylene (HDPE) chamber system arranged in parallel rows surrounded by washed stone. The CULTEC chambers create arch-shaped voids within the washed stone to provide stormwater detention, retention, infiltration, and reclamation. Filter fabric is placed between the native soil and stone interface to prevent the intrusion of fines into the system. In order to minimize the amount of sediment which may enter the CULTEC system, a sediment collection device (stormwater pretreatment device) is recommended upstream from the CULTEC chamber system. Examples of pretreatment devices include, but are not limited to, an appropriately sized catch basin with sump, pretreatment catchment device, oil grit separator, or baffled distribution box. Manufactured pretreatment devices may also be used in accordance with CULTEC chambers. Installation, operation, and maintenance of these devices shall be in accordance with manufacturer's recommendations. Almost all of the sediment entering the stormwater management system will be collected within the pretreatment device.

Best Management Practices allow for the maintenance of the preliminary collection systems prior to feeding the CULTEC chambers. The pretreatment structures shall be inspected for any debris that will restrict inlet flow rates. Outfall structures, if any, such as outlet control must also be inspected for any obstructions that would restrict outlet flow rates. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Operation and Maintenance Requirements

I. Operation

CULTEC stormwater management systems shall be operated to receive only stormwater run-off in accordance with applicable local regulations. CULTEC subsurface stormwater management chambers operate at peak performance when installed in series with pretreatment. Pretreatment of suspended solids is superior to treatment of solids once they have been introduced into the system. The use of pretreatment is adequate as long as the structure is maintained and the site remains stable with finished impervious surfaces such as parking lots, walkways, and pervious areas are properly maintained. If there is to be an unstable condition, such as improvements to buildings or parking areas, all proper silt control measures shall be implemented according to local regulations.

II. Inspection and Maintenance Options

A. The CULTEC system may be equipped with an inspection port located on the inlet row. The inspection port is a circular cast box placed in a rectangular concrete collar. When the lid is removed, a 6-inch (150 mm) pipe with a screw-in plug will be exposed. Remove the plug. This will provide access to the CULTEC Chamber row below. From the surface, through this access, the sediment may be measured at this location. A stadia rod may be used to measure the depth of sediment if any in this row. If the depth of sediment is in excess of 3 inches (76 mm), then this row should be cleaned with high pressure water through a culvert cleaning nozzle. This would be carried out through an upstream manhole or through the CULTEC StormFilter Unit (or other pre-treatment device). CCTV inspection of this row can be deployed through this access port to determine if any sediment has accumulated in the inlet row.

B. If the CULTEC bed is not equipped with an inspection port, then access to the inlet row will be through an upstream manhole or the CULTEC StormFilter.

1. Manhole Access

This inspection should only be carried out by persons trained in confined space entry and sewer inspection services. After the manhole cover has been removed a gas detector must be lowered into the manhole to ensure that there are not high concentrations of toxic gases present. The inspector should be lowered into the manhole with the proper safety equipment as per OSHA requirements. The inspector may be able to observe sediment from this location. If this is not possible, the inspector will need to deploy a CCTV robot to permit viewing of the sediment.

2. **StormFilter Access**
Remove the manhole cover to allow access to the unit. Typically a 30-inch (750 mm) pipe is used as a riser from the StormFilter to the surface. As in the case with manhole access, this access point requires a technician trained in confined space entry with proper gas detection equipment. This individual must be equipped with the proper safety equipment for entry into the StormFilter. The technician will be lowered onto the StormFilter unit. The hatch on the unit must be removed. Inside the unit are two filters which may be removed according to StormFilter maintenance guidelines. Once these filters are removed the inspector can enter the StormFilter unit to launch the CCTV camera robot.

C. The inlet row of the CULTEC system is placed on a polyethylene liner to prevent scouring of the washed stone beneath this row. This also facilitates the flushing of this row with high pressure water through a culvert cleaning nozzle. The nozzle is deployed through a manhole or the StormFilter and extended to the end of the row. The water is turned on and the inlet row is back-flushed into the manhole or StormFilter. This water is to be removed from the manhole or StormFilter using a vacuum truck.

III. Maintenance Guidelines

The following guidelines shall be adhered to for the operation and maintenance of the CULTEC stormwater management system:

A. The owner shall keep a maintenance log which shall include details of any events which would have an effect on the system's operational capacity.

B. The operation and maintenance procedure shall be reviewed periodically and changed to meet site conditions.

C. Maintenance of the stormwater management system shall be performed by qualified workers and shall follow applicable occupational health and safety requirements.

D. Debris removed from the stormwater management system shall be disposed of in accordance with applicable laws and regulations.

IV. Suggested Maintenance Schedules

A. Minor Maintenance
The following suggested schedule shall be followed for routine maintenance during the regular operation of the stormwater system:

Frequency	Action
Monthly in first year	Check inlets and outlets for clogging and remove any debris as required.
Spring and Fall	Check inlets and outlets for clogging and remove any debris as required.
One year after commissioning and every third year following	Check inlets and outlets for clogging and remove any debris as required.

B. Major Maintenance
The following suggested maintenance schedule shall be followed to maintain the performance of the CULTEC stormwater management chambers. Additional work may be necessary due to insufficient performance and other issues that might be found during the inspection of the stormwater management chambers. (See table on next page)

Major Maintenance *(continued)*

	Frequency	Action
Inlets and Outlets	Every 3 years	• Obtain documentation that the inlets, outlets and vents have been cleaned and will function as intended.
	Spring and Fall	• Check inlet and outlets for clogging and remove any debris as required.
CULTEC Stormwater Chambers	2 years after commissioning	• Inspect the interior of the stormwater management chambers through inspection port for deficiencies using CCTV or comparable technique. • Obtain documentation that the stormwater management chambers and feed connectors will function as anticipated.
	9 years after commissioning every 9 years following	• Clean stormwater management chambers and feed connectors of any debris. • Inspect the interior of the stormwater management structures for deficiencies using CCTV or comparable technique. • Obtain documentation that the stormwater management chambers and feed connectors have been cleaned and will function as intended.
	45 years after commissioning	• Clean stormwater management chambers and feed connectors of any debris. • Determine the remaining life expectancy of the stormwater management chambers and recommended schedule and actions to rehabilitate the stormwater management chambers as required. • Inspect the interior of the stormwater management chambers for deficiencies using CCTV or comparable technique.
	45 to 50 years after commissioning	• Replace or restore the stormwater management chambers in accordance with the schedule determined at the 45-year inspection. • Attain the appropriate approvals as required. • Establish a new operation and maintenance schedule.
Surrounding Site	Monthly in 1st year	• Check for depressions in areas over and surrounding the stormwater management system.
	Spring and Fall	• Check for depressions in areas over and surrounding the stormwater management system.
	Yearly	• Confirm that no unauthorized modifications have been performed to the site.

For additional information concerning the maintenance of CULTEC Subsurface Stormwater Management Chambers, please contact CULTEC, Inc. at 1-800-428-5832.

CULTEC™
Chamber of Choice™

CULTEC, Inc.
878 Federal Road • P.O. Box 280 • Brookfield, CT 06804
Phone: 203-775-4416 • Toll Free: 800-4-CULTEC • Fax: 203-775-1462
Web: www.cultec.com • E-mail: custservice@cultec.com

APPENDIX B

Stormwater Management System Owners/Operators

1.	Stormwater Management System Owners:	To be determined
2.	Current and future operators:	To be determined
3.	Emergency contact information:	To be determined
4.	Change of trustee:	To be determined
5.	Financial Responsible Party:	To be determined
6.	Routine Maintenance:	To be determined
7.	O&M activities:	To be determined
8.	Record keeping	To be determined

APPENDIX H

Long Term Pollution Prevention Plan

LONG-TERM POLLUTION PREVENTION PLAN

163 West Main Street
Groton Senior Center

GROTON, MASSACHUSETTS

Prepared For: TOWN OF GROTON
173 MAIN STREET
GROTON, MA

Prepared By: DUCHARME & DILLIS CIVIL DESIGN GROUP, INC
1092 MAIN STREET
BOLTON, MA 01740

February 9, 2018
5364

1.0 Summary

This Long-Term Pollution Prevention Plan (LTPPP) has been prepared by Ducharme & Dillis Civil Design Group, Inc. pursuant to the Massachusetts Stormwater Regulations. The proposed project includes the re-development of the existing Groton Senior Center located at 163 West Main Street. The work will reduce the stormwater runoff by improvements to the land cover but will also improve stormwater treatment through the installation of stormwater BMP's.

The layout of the proposed re-developed site has been carefully planned to maximize the distance from riverfront areas. The stormwater management system has been designed in accordance with the Massachusetts Stormwater Regulations to provide pretreatment of the stormwater prior to discharge.

2.0 Spill Prevention Plan

No hazardous materials other than normal cleaning items are expected to be stored on site after the construction period has ended.

It is expected that normal DEP notification procedures would be triggered for major spills such as heating oil or propane and natural gas leaks.

3.0 Stormwater System O&M

A Stormwater Operation & Maintenance plan has been prepared for the proposed stormwater management system. Refer to this document for details pertaining to the required inspections, routine maintenance and operation details including erosion stabilization.

4.0 Fertilizers, herbicides and pesticides

Application of fertilizer, herbicides and pesticides shall be performed in a manner consistent with the industry standards for the application.

No application of chemicals is to be performed within the stormwater management areas on the site.

5.0 Snow/Salt Management

5.1 Snow Plowing

It is expected that the site will be plowed by town personnel. Snow storage will be as far from the wetland resource area to the maximum extent practical as shown on the plans.

5.2 Salt/Sand Usage

It is expected that sanding and salting will be performed on an infrequent basis during times when unusually icy conditions persist for periods of time.

5.3 Street Sweeping

The Stormwater Operation & Maintenance Plan calls for the parking area to be swept in the spring, after the threat of winter precipitation has passed, and in the fall.

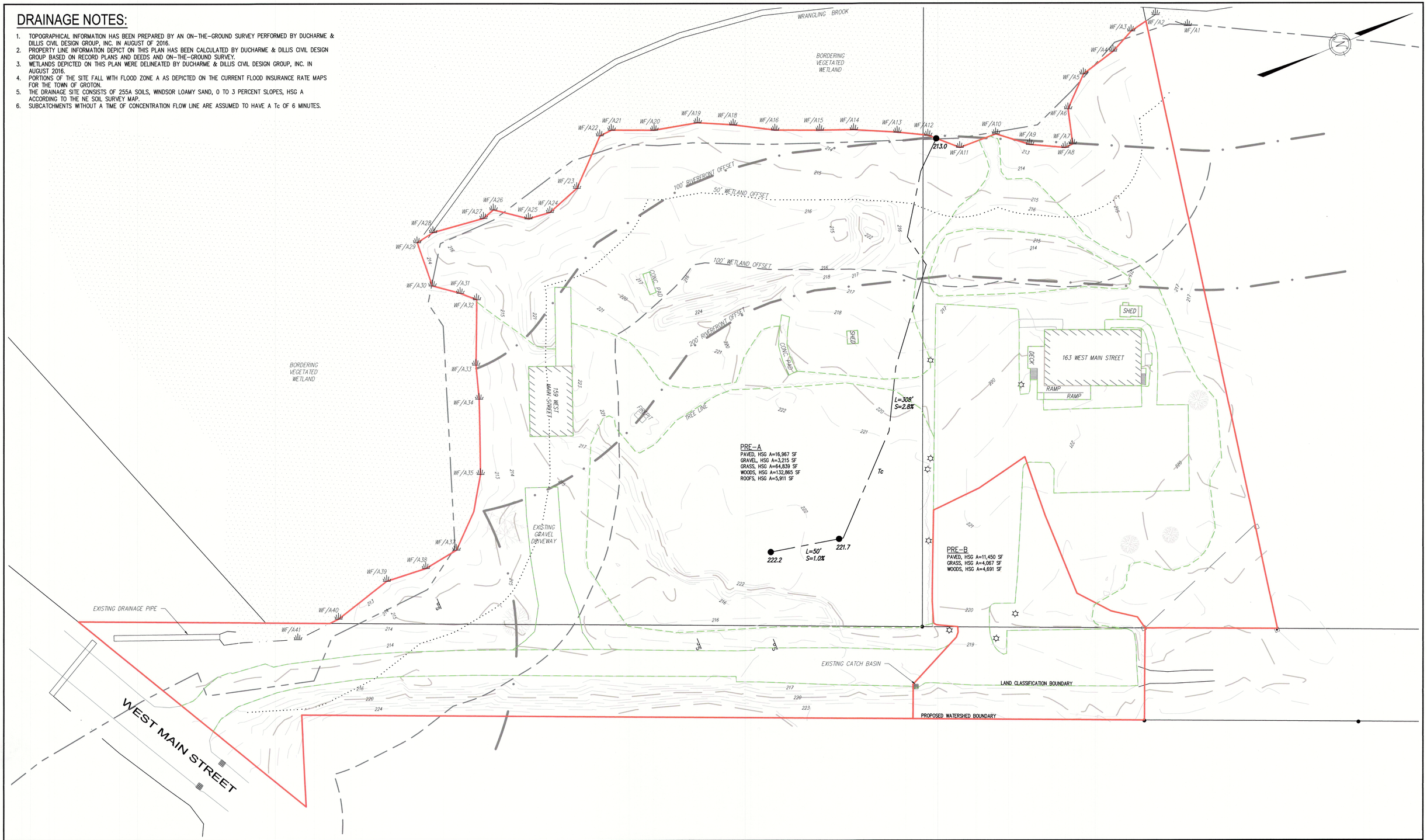
6.0 Waste Management

6.1 Solid Waste

A dumpster will be located on the site during and post-construction. This area will be the primary area for the on-site storage of solid waste prior to pick-up by a waste management company.

DRAINAGE NOTES:

1. TOPOGRAPHICAL INFORMATION HAS BEEN PREPARED BY AN ON-THE-GROUND SURVEY PERFORMED BY DUCHARME & DILLIS CIVIL DESIGN GROUP, INC. IN AUGUST OF 2016.
2. PROPERTY LINE INFORMATION DEPICT ON THIS PLAN HAS BEEN CALCULATED BY DUCHARME & DILLIS CIVIL DESIGN GROUP BASED ON RECORD PLANS AND DEEDS AND ON-THE-GROUND SURVEY.
3. WETLANDS DEPICTED ON THIS PLAN WERE DELINEATED BY DUCHARME & DILLIS CIVIL DESIGN GROUP, INC. IN AUGUST 2016.
4. PORTIONS OF THE SITE FALL WITH FLOOD ZONE A AS DEPICTED ON THE CURRENT FLOOD INSURANCE RATE MAPS FOR THE TOWN OF GROTON.
5. THE DRAINAGE SITE CONSISTS OF 255A SOILS, WINDSOR LOAMY SAND, 0 TO 3 PERCENT SLOPES, HSG A ACCORDING TO THE NE SOIL SURVEY MAP.
6. SUBCATCHMENTS WITHOUT A TIME OF CONCENTRATION FLOW LINE ARE ASSUMED TO HAVE A Tc OF 6 MINUTES.



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www.DucharmeandDillis.com

OWNER:
TOWN OF GROTON
173 MAIN STREET
GROTON, MASSACHUSETTS

APPLICANT:
TOWN OF GROTON
173 MAIN STREET
GROTON, MASSACHUSETTS

SCALE:
30 0 15 30 60 120
1 in. = 30 ft.

DATE: 2/9/18
DESIGN BY: JPL
DRAWN BY: JPL
CHECKED BY: GSR

PRE DEVELOPMENT WATERSHED MAP
WEST MAIN STREET
GROTON, MASSACHUSETTS

NO.	DATE	DESCRIPTION	BY

JOB NO. 5364
DRAWING NO. 5364-PRE
SHEET NO. 1

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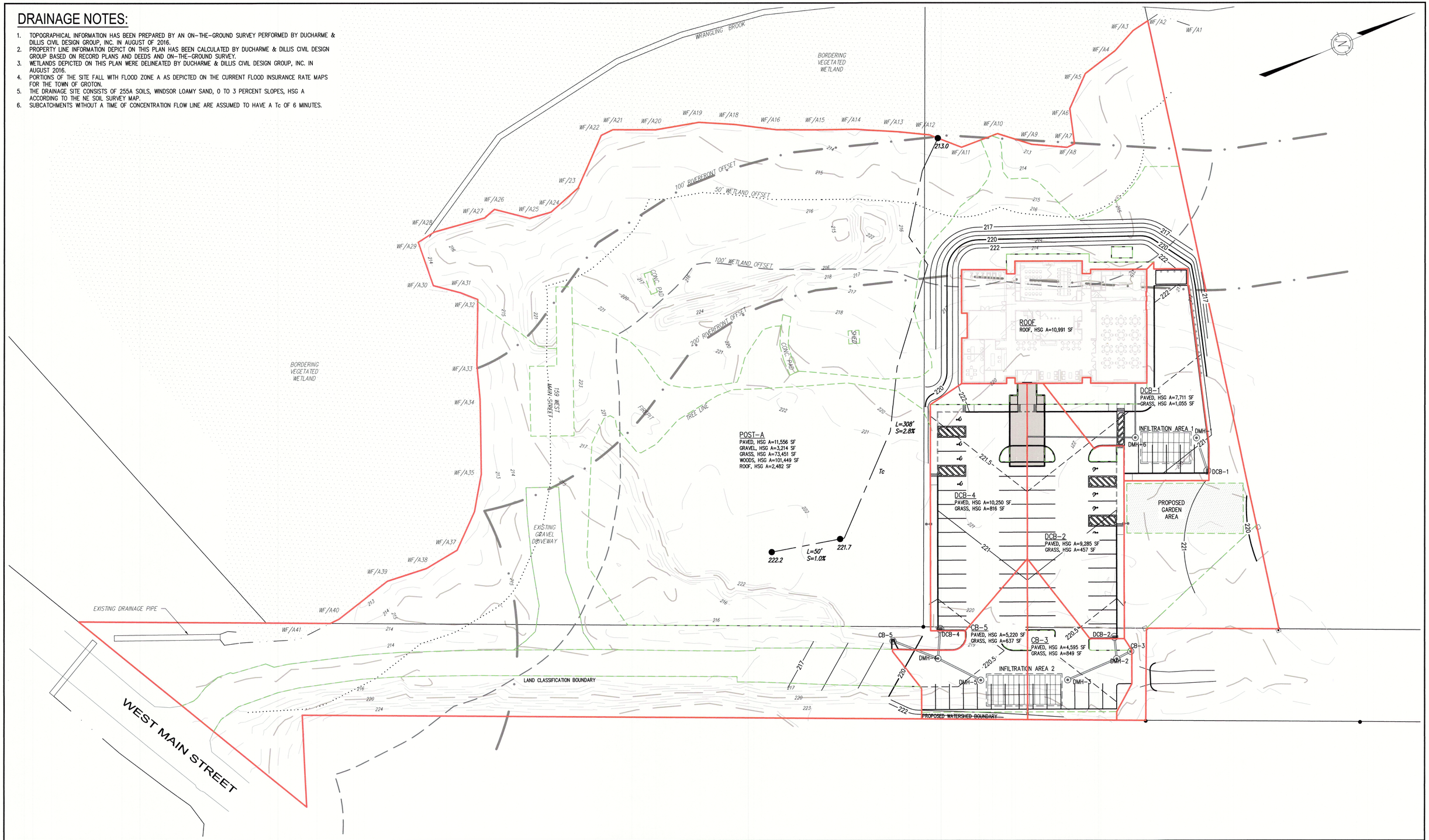

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GROTON, MASSACHUSETTS

SCALE:
30 0 15 30 60 120
1 in. = 30 ft.

DATE: 2/9/18
DESIGN BY: JPL
DRAWN BY: JPL
CHECKED BY: GSR

POST DEVELOPMENT WATERSHED MAP
WEST MAIN STREET
GROTON, MASSACHUSETTS

NO.	DATE	DESCRIPTION	BY

JOB NO. 5364
DRAWING NO. 5364-POST
SHEET NO. 1